SCIENTIFIC AMERICAN

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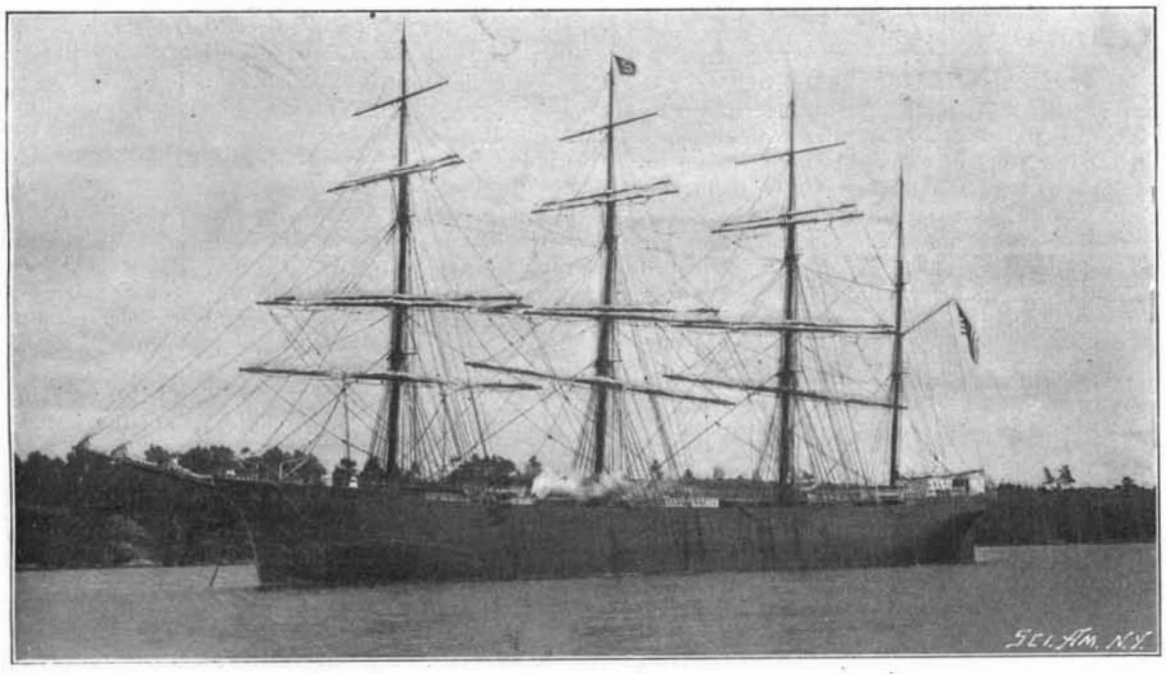
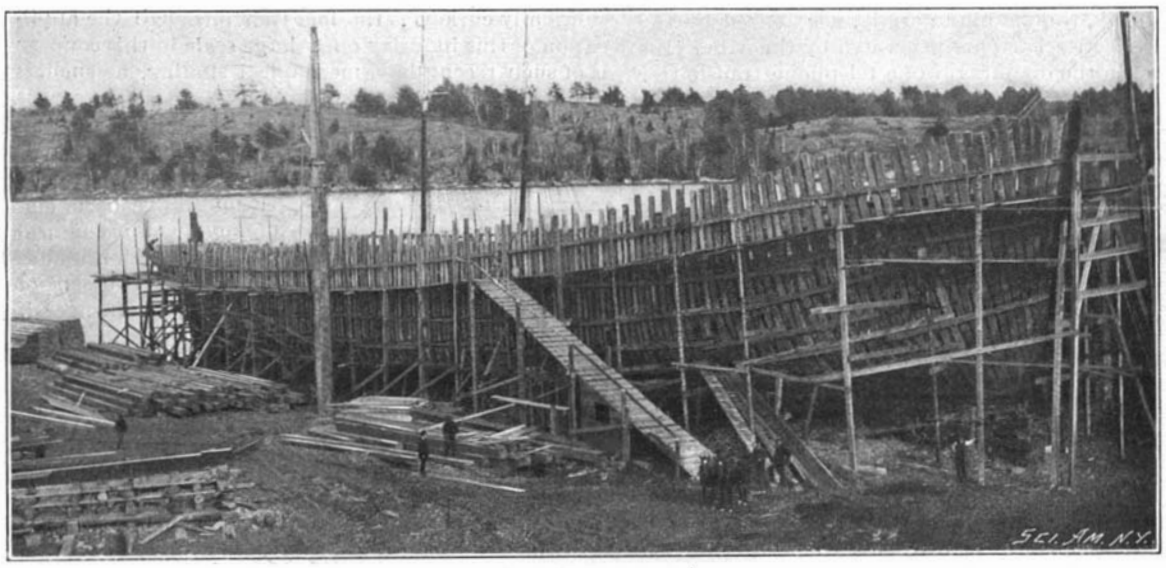
A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. LXXXIII.—No. 12. ESTABLISHED 1845. NEW YORK, SEPTEMBER 22, 1900. [$3.00 A YEAR. WEEKLY.

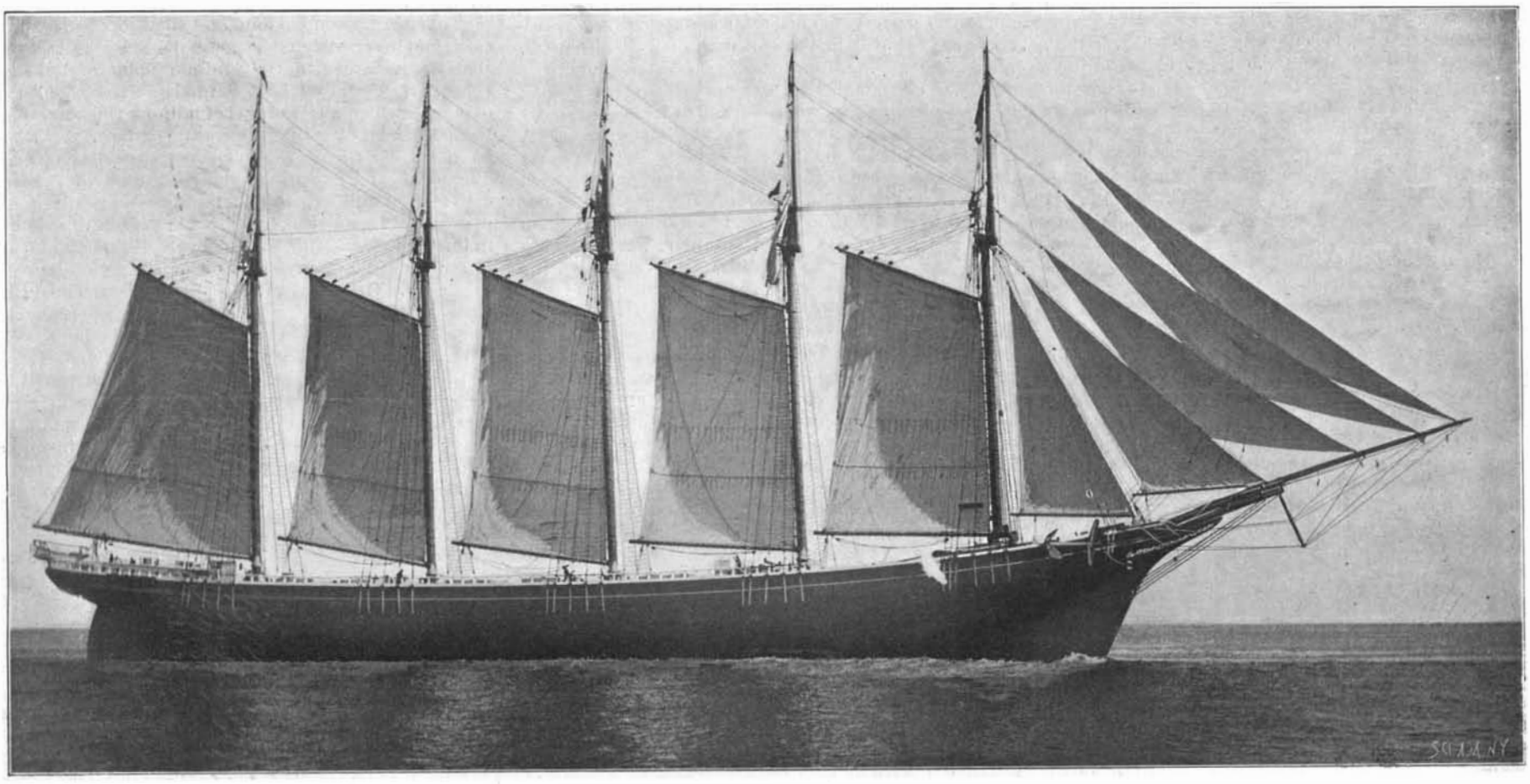


"Edward Sewall"—Largest Steel Sailing Ship Built in America.



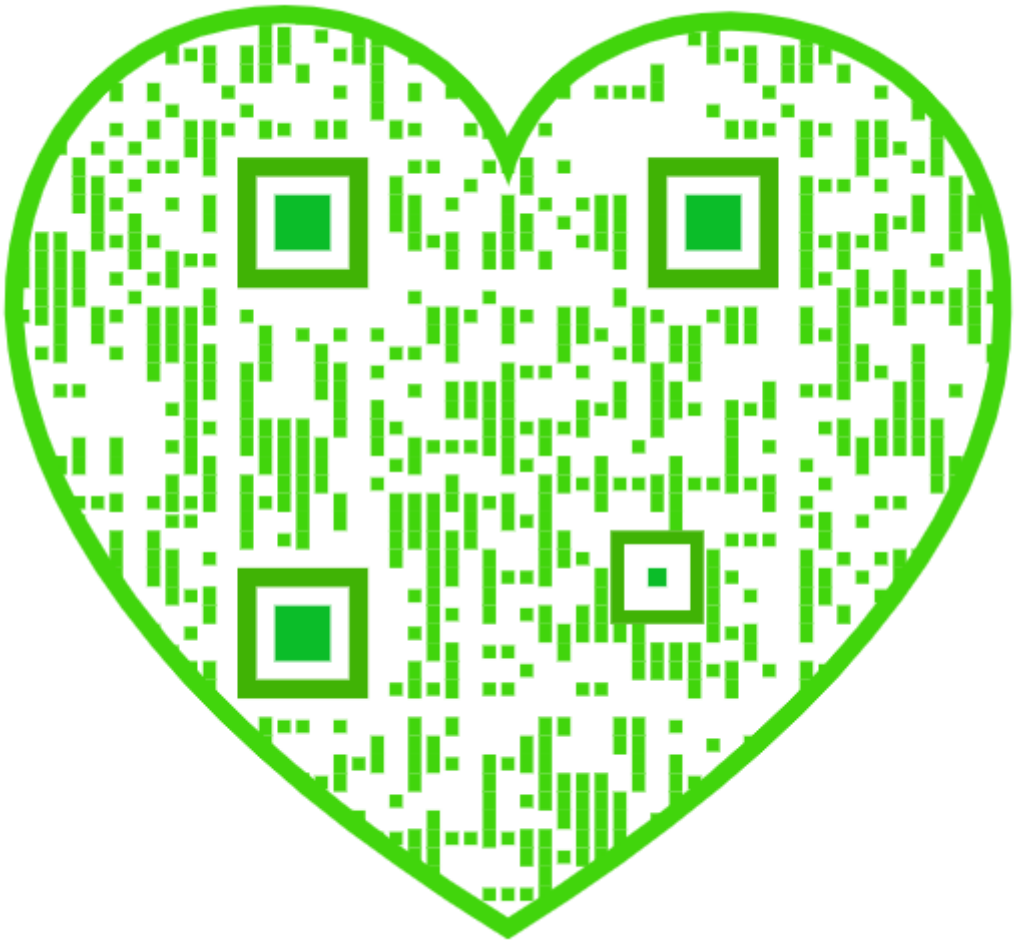
Typical Wooden Schooner on the Stocks.

"Dirigo"—First Steel Sailing Ship Built in the United States.



Five-masted Schooner "Helen Martin." Length, 281 feet 6 inches; beam, 44 feet 8 inches; depth, 20 feet 9 inches; tonnage, 2,265.

THE NEW ERA OF THE AMERICAN SAILING VESSEL.—[See page 182.]



Scientific American.

ESTABLISHED 1845

MUNN & CO., - - - EDITORS AND PROPRIETORS.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, - - NEW YORK.

TERMS TO SUBSCRIBERS

One copy, one year, for the United States, Canada, or Mexico $3.00
One copy, one year, to any foreign country, postage prepaid. £0 16s. 5d. 4.00

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (Established 1845) ..... $3.00 a year.
Scientific American Supplement (Established 1876) ..... 5.00 "
Scientific American Building Edition (Established 1885). ..... 2.50 "
Scientific American Export Edition (Established 1878) ..... 3.00 "

The combined subscription rates and rates to foreign countries will be furnished upon application.
Remit by postal or express money order, or by bank draft or check.
MUNN & CO., 361 Broadway, corner Franklin Street, New York.

NEW YORK, SATURDAY, SEPTEMBER 22, 1900.

AWARDS TO AMERICAN EXHIBITORS AT PARIS.

The authorities of the Paris Exposition have made some amends for their delay in opening the gates to an incomplete World's Fair, by commendable promptness in the matter of making awards. The deliberations of 121 juries were conducted during the hottest months of the year, which added to the difficulty of passing upon eighty thousand entries in the time at their disposal. The question of the personnel of the juries, their organization and the value of the awards, while interesting subjects, need not concern us at the present time; but there is one phase of the matter which is remarkable: this is the high rank which the United States has taken both as regards entries and awards.

The total number of entries was 79,712, France naturally coming first with 31,946; then follows the United States with 6,674, Italy with 3,188, Russia with 3,113, Germany with 2,586, and Great Britain with 1,688 entries. Strange to say, the largest exhibitors next to the United States were countries of minor importance as regards the general interest of their exhibits; thus, Hungary had 3,304 entries, Portugal 3,381 and Mexico 3,419, while some countries, such as Jamaica, Port d'Espagne, Singapore and West Australia, had only one or two entries.

Disregarding the lower forms of award, such as "honorable mention," bronze medals and silver medals, let us consider the two highest premiums, the gold medals and the much-coveted "Grands Prix," which is the highest distinction that any exhibitor can obtain except, possibly, by securing a decoration. Our 6,674 entries have obtained for the exhibitors no less than 200 Grands Prix and 642 gold medals. The "entries per award," as regards the Grands Prix, were 33·3, and 10·4 as regards the gold medal. While we were out-percentaged by some of the other nations, at the same time the showing is a good one when the enormous number of our entries is considered, for we follow France very closely. Her entries per award were 27·3 for the Grand Prix and 5·7 for the gold medal. The United States exhibitors have distinguished themselves in every branch of art, education, and industry. In education we follow France, the jury having given us in this class 32 Grands Prix and 63 gold medals, which is a wonderful showing. In the fine arts it must be said that our success is not as great as that of Italy, Germany, and Great Britain, but otherwise we have received the largest number of awards, namely, 5 Grands Prix and 14 gold medals. In the liberal arts we have also taken high rank, being excelled only by France and Germany, all other countries following the United States. In the classes under this general head we took 17 Grands Prix and 41 gold medals. In machinery we are also excelled by France and Germany, taking 10 Grands Prix and 26 gold medals; in electricity the same conditions prevail, France and Germany exceeding us only in the number of awards, the United States taking 6 Grands Prix and 23 gold medals. In civil engineering and transportation we took 16 Grands Prix and 65 gold medals, and we are again excelled only by France and Germany, both of which have wonderful exhibits in this class. In agriculture, the United States did exceedingly well, taking 22 Grands Prix and 64 gold medals, but in this class we have to bow before Roumania and Russia, these countries having succeeded in each carrying away over a hundred prizes. In horticulture, forestry and sport, the United States did fairly well, as they also did in food products. In mining and metallurgy the United States ranks next to France, taking 18 Grands Prix and 42 gold medals, in this case distancing Germany by more than 38 prizes. In furniture and decoration we also take a prominent position, coming directly after France and Germany. We are excelled by quite a number of countries in textiles and clothing. In the chemical industries we obtained 7 Grands Prix and 26 gold medals, this number being excelled only by Germany and Russia. In social economy and hygiene we take a very high place, receiving 28 Grands Prix and 106 gold medals, coming next to France. In the army and navy we did not have as good a showing as France, Russia and Germany, but we lead Great Britain and other countries.

We have every reason to feel gratified with the remarkable showing, for it must be remembered that to exhibit in Paris necessitates the expenditure of considerable money for transportation of exhibits and maintenance. The majority of the United States exhibits had, of course, special representatives to give information relative to their display. It is much more difficult for an American firm to install a satisfactory exhibit than a British or German firm. If there is another international exposition in the course of the next ten or fifteen years, we may expect that the United States will take even a more prominent part than she has heretofore, as she is now doing in the export trade of the world.

POULSEN'S TELEGRAPHONE.

On another page will be found a full description by our Paris correspondent of an invention which has not only added to our store of electrical apparatus an instrument destined to take its place in our daily life, but also forcibly demonstrated that commonplace physical phenomena, so commonplace in fact that they are no longer remarked, when studied and fully grasped by a master mind, may be applied to ends little dreamt of. The invention in question is a phonograph which magnetically records the sounds converted into electric vibrations by a telephone.

In every college lecture room a simple experiment in magnetism is performed, which has been so often described that it should be familiar to everyone—an experiment which consists in writing with a magnetic pen upon a uniformly magnetized steel plate. At certain places the plate's magnetism is enfeebled, and at others strengthened; so that when the iron filings are distributed over the plate, the letters or words written by the magnetic pen immediately become visible. Upon this simple principle of variable magnetization, Poulsen's "Telegraphone" is based. Instead of a steel plate, a steel wire or ribbon is employed, which is passed between the poles of an electro-magnet and permanently, though ununiformly, magnetized by the variable electric currents generated by the vibrations produced in the diaphragm of a telephone transmitter by acoustic impulses. The record thus magnetically transcribed can be reproduced at a telephone receiver by causing the wire or ribbon to pass again between the electro-magnetic poles, so that variable electric currents are produced in the circuit to affect the diaphragm of the receiver.

Although the physical basis of the telegraphone has long been known, it is none the less astonishing to find that the differences of magnetism in the wire or ribbon are sufficiently pronounced, and that the magnetic and electric forces entering into consideration are intense enough to secure the result desired. Indeed, Poulsen was compelled to produce a working model in applying for his patent, in order to convince the skeptical authorities that his invention was based on physically sound principles.

A quarter of a century ago Bell invented a device which aroused no little interest by reason of an exceptional simplicity which contrasted sharply with the manifold phenomena of motion which it was its function to reproduce. Indeed, there is probably no other apparatus in the entire field of technology which transmits such complex movements with such simple means. A small magnet, an iron core or two, a steel plate, wire coils, and two conductors, that was all which Bell used in transmitting the extremely intricate and swiftly changing acoustic vibrations of the human voice. A careful consideration of the telegraphone proves that its Danish inventor has devised an instrument which is almost as ideally simple as that of Bell.

With the invention of the telegraphone, Poulsen may incidentally have solved a problem which has presented unusual difficulties. What the relay is to the telegraph, his instrument may possibly be to the telephone. In telegraphy, as we all know, the very long conductors employed increase the resistance to such an extent that the electric current can be transmitted only to limited distances, for which reason a relay is used at the end of a circuit to serve as an automatic key for the next following circuit. The conditions are exactly similar in telephony. The longer the wire, the feebler will the current be at the terminals. For years it has been the self-imposed task of inventors to devise a telephone relay which would answer the purpose of the large telephone systems. Poulsen's apparatus seems designed to meet the requirements which can be exacted of a telephone relay.

But the telegraphone may play not merely the part of a relay; it may even perform functions similar to those of the duplex telegraph. For the last decade an apparatus has been used to send two, and even four or more messages over a single telegraph wire. In telephony, on the other hand, each conversation, as a general rule, must be transmitted by a separate circuit. In Germany, Sweden and England a device is used whereby it is possible to transmit three conversations over two circuits. The task of providing a duplex telephone is, therefore, nearing its accomplishment. The problem seems to have been completely solved by Poulsen's collaborator, Pederson, whose invention is described in the article already referred to.

Although we have not had an opportunity of examining Poulsen's telegraphone in this country, and although the account of our correspondent is based largely upon tests made at the Paris Exposition, we are, nevertheless, assured that the instrument has been used in the Danish telephone systems with no little success.

MECHANICAL STOKING IN THE UNITED STATES.

Among the signs of the times in the world of steam engineering is the wonderful growth during the past decade of mechanical stoking. Not merely is this scientific method of firing being adopted for isolated steam plants of moderate capacity, but it is safe to say that mechanical stoking has come to be regarded as a *sine qua non* in the equipment of a large modern power station. Just how extensive has been the growth of this industry may be judged from the fact that one firm alone in this city, who handle what is probably the most successful form of stoker in existence, are now installing at the power houses of the Metropolitan Street Railway Company of this city, mechanical stokers for a total of 66,000 horse power of boilers, while they are, furthermore, equipping over 225,000 horse power of boilers in various parts of the United States.

These figures are particularly striking when we bear in mind that the era of the rapid growth of the industry in this country has been confined almost exclusively to the decade which is now drawing to a close. As a matter of fact, at the commencement of this decade there were only three mechanical stokers manufactured in this country, and the activity which is now manifest in the invention and improvement of existing forms is due to the stimulus offered by the excellent results achieved by the Murphy, the Brighman, and the Roney types. The later forms are almost entirely improvements upon designs which had been patented either here or abroad previous to 1885.

Equally curious is the fact that although the application of this industry on a large scale in this country is of such recent date, mechanical stoking, as such, is as old as the steam engine itself. The earliest records of this subject show that the first mechanical stoker to be patented was one designed by the inventor of the steam engine himself, and it is to the credit of James Watt that the design, crude as it may have been, embodies the essential features of any good mechanical stoker. The coal was fed at the furnace door, and as it became coked was pushed back over two sets of horizontal grate bars. At the front of the furnace it became coked, and the gases from the coking fuel passed over the partially coked and live fuel in the middle and at the back of the grate, where they were completely consumed. Such, in principle at least, is the mechanical stoker of to-day.

The popularity of mechanical stoking is to be set down to the relative obvious advantages over stoking by hand. In the first place, the feeding of the fuel is constant and even. The fresh fuel being introduced only at the front of the furnace is very gradually coked, the liberated gases meeting with a supply of fresh air led in by special ducts to provide the necessary oxygen for combustion, and the bed of incandescent fuel over which the gases pass serves to raise their temperature to the ignition point and secure their perfect combustion. A further advantage is the ease with which a bed of fuel of uniform thickness may be maintained over the whole grate surface. Furthermore, there is the prevention of a serious loss of heat due to the necessarily frequent opening of the fire doors in hand firing, which not only reduces the temperature of the furnace by allowing streams of cold air to impinge on the tube sheets, but subjects the latter to serious strain, and is a fruitful source of leaking tube ends. Other advantages are the great saving in labor in plants which require more than one fireman in firing by hand, and the abatement of the smoke nuisance, due to the very perfect combustion. A further improvement, which is readily appreciated in the engine room, is the uniformity of the steam pressure, rendering the boiler better able to respond to heavy demands for steam. It is stated by an inventor who has had more to do with the modern development of mechanical stoking in this country than any other man, that a well designed stoker, as compared with a hand-fired furnace, will save ten per cent in the fuel, while one man operating a stoker will do as much as two men engaged in hand firing; this last estimate referring to the smaller plants. Where the boiler plant is of such a size as to warrant the installation of coal and ash handling machinery, the reduction of labor is estimated by the same authority to be about seventy-five per cent.

In view of the remarkable growth of the industry we are publishing in the SUPPLEMENT a series of illustrated articles, commencing with the issue of last week, in which some of the most representative forms of mechanical stokers will be fully illustrated and described.

ENGLISH VS. GERMAN ATLANTIC LINERS.

It is rumored in English shipping circles that the Cunard Steamship Company are going to construct two new liners, with the object of lowering the records for the transatlantic journey, recently established by the "Deutschland" and "Kaiser Wilhelm der Grosse." The rumor, however, is generally discredited, since the English shipping companies have abandoned the contest for speed records. The present tendency is not to build faster boats, but larger and more comfortable vessels. This fact has been irrevocably established by the White Star liner "Oceanic." This vessel was not built with a view to racing across the Atlantic at a tremendous speed, but was intended to carry a larger tonnage and a greater complement of passengers at a steady speed with the maximum of comfort. The "Oceanic" has been such a tremendous success that the White Star Line have another vessel, even larger than the "Oceanic," in contemplation, and the various other companies, profiting by this experience, are following suit.

There are several salient points which militate against the English companies attempting to lower the speed records. In the first place, the German steamship companies are heavily subsidized by their government. Therefore, they need not display that economy which the English companies have to observe. The latter receive not a farthing from their government, and if the German companies were deprived of their state subsidy, and were to continue their business on the same lines that they now practice, they would incur a very heavy loss. Then again there is the question of coal consumption, which is troubling the English companies a great deal just at present. It is estimated that if the "Lucania" or "Campania" were to run at 22 knots instead of 20, which is their present average speed, they would consume an extra 300 tons of coal a day. This would mean something like $2,250 over and above the present daily cost of running. Consequently, it will be readily recognized that the English companies will not incur such an extra heavy expense for the purpose of saving a few hours upon the journey.

THE TEMPLE LIBRARY AT NIPPUR.

The remarkable discoveries made by the Pennsylvania University expedition at Nippur under Prof. Hilprecht have awakened great interest, as by these discoveries the history of Babylonian civilization has been carried back to a period more than 7,000 B. C. Prof. Hilprecht has now returned to Constantinople, and has described some of the chief results of this year's work in the old city. The library of the great temple was the most important discovery which was made. Prof. Hilprecht stated some eleven years ago that the remains of the library would be found at the very place where the discovery was made. In three months no less than 17,200 tablets bearing inscriptions in cuneiform characters had been found. They relate to business contracts, conveyances, letters, etc. The latest discoveries disclose the fact that the tablets are historical, philological, and literary, treating of mythology, grammar, lexicography, science, and mathematics. It is thought that when they have all been deciphered, they will enable us to obtain a very adequate idea of life in Babylonia. None of the documents bear a later date than 2280 B. C. It is probable that the library was destroyed during the invasion of the Elamites, which occurred at this date.

Prof. Hilprecht considers that at the present rate of working, five years will be necessary to excavate and examine the contents of the great library. He considers that the unexplored part will yield 150,000 tablets. We know that the library was of great importance in early Babylonia, and was the chief college for instruction in law and religion, as well as in all other studies. It is probable that no example of a literary treasure trove in the world's history, not even in Egypt, will result in so complete a recovery of the records of ancient civilization. The work of exploration has been stopped on the library in order to continue the work at the temple and to complete the examination of the southern and eastern lines of the walls of the fortifications. The numerous weapons were found along the fortifications in the lower strata. This affords material for determining the methods employed by the besieging armies in the bloody early period of Babylonian history. In the course of the present excavations the palace belonging to the pre-Sargonic periods was uncovered beneath an accumulation of 70 feet of rubbish on the southwestern side, which divided Nippur in two parts. Prof. Hilprecht considers that this palace, which has a frontage of 600 feet, will probably be found to be the palace of the early priest-kings of Nippur. The few rooms excavated have given valuable results in the way of tablets, cylinders and figurines. It is hoped that statues will also be found. A large building with a remarkable colonnade, which was discovered in the first campaign, has been completely excavated.

An important tomb has also been discovered. The French expedition has done good work at Tello, on the southeast side of the great canal connecting the Tigris with the Euphrates. The chief finds of the year are about 10,000 inscribed tablets. A third expedition that Germany arranged has been at work in Babylonia since the spring of 1899. The greatest success of the year is that made by the American expedition.

DISTANT WATER POWERS.

BY ALTAN D. ADAMS.

Unfortunately for the average investor in schemes for long distance transmission of water power by electric methods, the demonstration of financial success in this line has not been made as complete as that of engineering possibility. It seems timely, therefore, to call attention to a few facts in the interest of the man who pays the bills. An attempt is here made to show that the fundamental objection to the electrical transmission of energy at high pressures, over long distances, under ordinary conditions, lies not in the limits of practical voltage, but in the large cost of and material losses in the necessary equipment. The great problem that must be solved in order to make electrical transmission of water power generally practical, over long distances, lies not so much in the direction of higher pressures as in the discovery of cheaper apparatus for its transmission to towns and cities where coal can be had at usual prices.

Before the wholesale transmission of energy from falling water, over long distances, is generally adopted, it must be shown that the transmitted energy can be delivered at the points of use for not more than the cost of the same amount of energy there developed from coal. When those who see great advantages in the delivery of power at long distances from the place of its development have found their Utopia, in a source of absolutely free water power, they will still be unable to transmit it to far-away cities, in competition with the steam or gas engine, with coal at ordinary prices, because of the large investment for lines and machinery and the labor item of operation. So limited are the possibilities of electric power transmission, under the conditions imposed by long distances, that if cheap water power were only a single mile distant from large cities, it would not pay to transmit it, if the long distance equipment had to be employed for the purpose. In other words, the cost of, and losses in, the electrical machinery necessary for the transmission of power to great distances more than offset the usual difference between the cost of water power at a cheap source and the cost of its production at the point of use from coal at ordinary prices. Again, the transmission of power on a large scale, between distant points, cannot be fairly confounded with the distribution of power over even great areas to small consumers, since widely scattered small power users are not in a position to have their power economically generated at the points of use. The measure of warrant for the transmission of power between distant points is the difference in the cost of power production at the points in question. If it is proposed to transmit the energy of falling water to a distant city or great manufacturing plant, the inducement to the project is the difference between the cost of unit energy from the water power and the cost of the same energy unit produced by fuel consumption at the point of distribution or use. The power of falling water is so easy to grasp, and apparently so cheap, that it has long been regarded as peculiarly suited to long distance electric transmission. It is a matter of history that many of the best water powers in the United States have cost sums to develop on which the power delivered furnishes but a poor return. Without discussing the actual cost of water power development which often runs from $100 to $150 per delivered horse power, a moderate yearly price for such power may be assumed at $15 per horse power year. The combined efficiencies of the electric transmission equipment is 62 per cent, assuming 90 per cent each for dynamos and motors, 95 per cent each for two sets of transformers, and 85 per cent for the line efficiency. The cost of water power for each horse power year delivered at the receiving station is, therefore, $15 \div 62 = 24{\cdot}19$ dollars. The cost of the electrical transmission equipment is 86·15 dollars per horse power of delivery capacity at the center of distribution or use at prices of $25 per horse power capacity of dynamos and motors and $10 per horse power for transformers, the total dynamo and motor capacity being 2·45 and transformer 2·49 times the power delivery. Allowing $60 per brake horse power capacity for the machinery of a steam plant at the point where the transmitted power is to be used, the additional expense involved by the transmission equipment is $86{\cdot}15 - 60 = 26{\cdot}15$ dollars per delivered horse power. Taking 16 per cent of this extra outlay for the electric equipment gives $26{\cdot}15 \times 0{\cdot}16 = 4{\cdot}18$ dollars, the annual charge for interest, depreciation, repairs, insurance, and taxes on the additional investment per delivered horse power. Adding the above cost of water power and the annual charges just found gives $24{\cdot}19 + 4{\cdot}18 = 28\ 37$ dollars, and this sum, less the cost of coal per horse power year at the steam plant, or $28{\cdot}37 - 11{\cdot}25 = 17{\cdot}12$ dollars, is the excess in cost per horse power year delivered by the electric transmission over the cost of the same power from a local steam plant. In order that the electric transmission may deliver power at the same cost as a local steam plant, the cost of water power per delivered horse power year must not exceed $11{\cdot}25 - 4{\cdot}18 = 7{\cdot}07$ dollars, and this reduces the charge per horse power year at the water power to $7{\cdot}07 \times 0{\cdot}62 = 4{\cdot}38$ dollars, on the basis of no outlay whatever for line conductors.

This comparison assumes the same labor of operation and building cost for the two stations and electric transmission as for the single steam plant. Turning again to the electric transmission equipment, consisting of dynamos, two sets of transformers, motors, and the line conductors, and omitting from the consideration the line loss, the combined efficiency of the other elements is $0{\cdot}95 \times 0{\cdot}90 \times 0{\cdot}95 \times 90 = 0{\cdot}73$, so that for each horse power delivered by the motor, $1 \div 0{\cdot}73 = 1{\cdot}37$ horse power must be supplied to the dynamo. The capacity of each element now is, making that of the motor as 1, step-down transformer $1 \div 0{\cdot}9 = 1{\cdot}11$, step-up transformer $1{\cdot}11 \div 0{\cdot}95 = 1{\cdot}16$, dynamo $1{\cdot}16 \div 0{\cdot}9 = 1{\cdot}22$. On the same basis as above the cost of the electrical equipment is now, motors and dynamos $(1 + 1{\cdot}22)\ 25 = 55{\cdot}50$ dollars, transformers $(1{\cdot}11 + 1{\cdot}16)\ 10 = 22\ 70$ dollars, a total of 78·20 dollars for each horse power of delivery capacity. The yearly charges on this sum for interest, insurance, taxes, depreciation and repairs, taken at 16 per cent, as above, amount to $78{\cdot}20 \times 0{\cdot}16 = 12{\cdot}51$ dollars. As the cost of coal at $3 per ton is only 11·25 per horse power year, for a first-class steam plant, the delivered power from a system of long distance electric transmission is $12{\cdot}51 - 11{\cdot}25 = 1{\cdot}26$ dollars per horse power year more expensive than the same power from a local steam plant, it being assumed that the transmission line costs nothing and that there is no power lost in it. Or, to illustrate the case, suppose that great central power stations could have free water power if they would use it to drive dynamos, send the resulting energy through two sets of transformers and then into electric motors to be used in driving their regular electrical equipment for local service, the interposed dynamos, transformers, and motors being paid for at above prices. Should the central stations accept such a proposition, power delivered to their regular electric generators would cost 1·26 dollars more per horse power year than the value of the fuel outlay they would save, though there would be no line loss or cost.

These figures are based on the operation of steam engines; if gas engines, which only consume about two-thirds of the coal for an equal output, are used, the result is still less favorable to the electric transmission. It is thus evident that no possible increase in practical voltage, which can only decrease but never do away with the cost of and losses in line conductors, can ever warrant the long distance electric transmission of water power to points where coal can be had at common prices, since such transmissions would not pay if the line dissipated no energy, cost nothing, and water was free at the generating station.

EXPORTS OF AMERICAN COAL.

Exports of coal from the United States during the year 1900 are likely to reach $20,000,000 in value, against $10,000,000 in 1896 and $6,000,000 in 1890. The figures of the Treasury Bureau of Statistics show that the exports of coal from the United States during the 7 months ending with July, 1900, are 50 per cent in excess of those during the corresponding months of last year and double those of the corresponding months of 1898. In the 7 months ending with July, 1898, the exports of coal from the United States were 2,375,451 tons; in the same months of 1899 they were 3,006,032 tons, and in the corresponding months of 1900 they were 4,601,755 tons. During the period from 1890 to 1900 the exportation of coal from the United States has quadrupled, but the principal growth has been in the years 1898, 1899, and 1900. While this growth is observable in the exports to all parts of the world, it is especially marked with reference to our exports to the American countries. To British North America, the exports in the 7 months of 1898 were 1,788,398 tons and in the 7 months of 1900, 3,253,803 tons. To Mexico the exports in the 7 months of 1898 were 243,938 tons and in the corresponding months of 1900, 415,834 tons. To Cuba the exports have more than doubled, being in the 7 months of 1898, 114,655 tons and in the 7 months of 1900, 241,712 tons; while to Porto Rico the exports increased from 2,621 tons in the 7 months of 1898 to 15,313 tons in 7 months of 1900. To the Hawaiian Islands, the exports of the 7 months of 1899 were 10,381 tons and in the corresponding months of 1900, 21,001 tons, thus more than doubling in a single year. To the Philippine Islands the exports in the 7 months of 1898 were 4,810 tons, and in the 7 months of 1900, 41,068 tons, or eight times as much in 1900 as in 1898.

The experiments with American coal which the Europeans have made in the last two or three years seem to have proved successful, as the exports to Europe, which in the 7 months of 1898 amounted to only 4,507 tons, were in the corresponding months of 1900, 278,572 tons. Of this, 187 tons went to the United Kingdom, 4,028 tons to Germany, 77,497 tons to France, and 196,950 to other European countries.

THE SPIRAL-GLOBE LAMP.

The employment of incandescent lamps having bulbs of plain glass leaves much to be desired from a hygienic point of view, because the intensity of the dazzling light radiated by the filament is certain to injure the eyesight. Hence shades are often employed to intercept the rays of light, or ground glass bulbs to conceal the filament. But these remedies both involve an increase in the cost of current since a large percentage of the light is absorbed. It is necessary, in order to obtain the same illuminating effect, to have lamps of higher candle power with consequent increase in consumption of current. It is the object of the inventor of the lamp which is herewith illustrated to remedy the defect and to enable the consumer to use a plain glass lamp without liability of injuring the eyesight, and to utilize all the current instead of partially obscuring or absorbing the light in order to render the lamp serviceable.

The new lamp consists of a plain glass bulb surrounded by an envelop composed of a spir ally-wound rod of plain glass inclosed within an outer protective plain glass globe. The effect of this combination is twofold; for although the main object, as above stated, is to conceal the filament without loss of light, the result is, as a matter of fact, to increase the effective illumination of the lamp, the spirally-wound glass rod constituting a double convex lens throughout its entire length and serving so to refract and diffuse the rays as not only entirely to prevent the outline of the filament from being perceived by the eye, but also actually to increase the photometric value of the lamp in the direction in which it is most desirable that the light should be rendered available.

These lamps, which have a most pleasing and beautiful effect, are now being manufactured in England by the Spiral Globe Limited, of 28 Bush Lane, Cannon Street, London, E.C., and on the Continent by Johann Kremenezky, of Vienna; while companies are in process of formation to manufacture the lamps under license of the Spiral Globe Limited in other European countries.

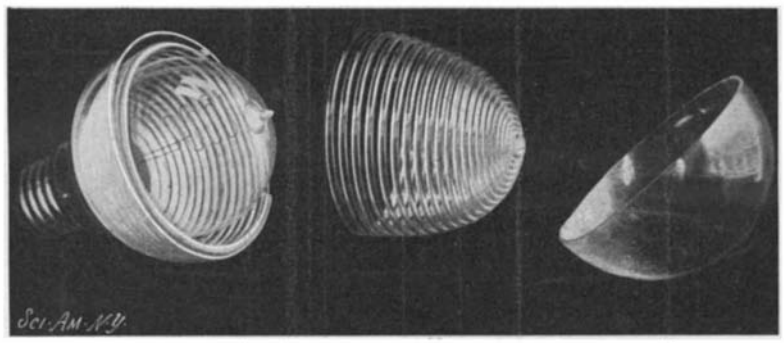
AN AUTOMATIC OVAL WOOD DISH MACHINE.

Oval wood dishes are exceptionally good and inexpensive receptacles for butter, lard, cheese, berries, and the like, and are for that reason very widely used by grocerymen. A machine has recently been placed upon the market by the Defiance Machine Works, of Defiance, Ohio, which is designed to make these dishes as quickly and neatly as only a good automatic machine can make them.

The machine is supported by a massive frame cored in the center and provided with a broad floor-base. The knives employed consist of a revolving cutter which cuts the dish by a single continuous cut; and two facing knives for shaving off the surface of the block between each cut of the dish-knife and making the dishes of uniform size, with straight edges.

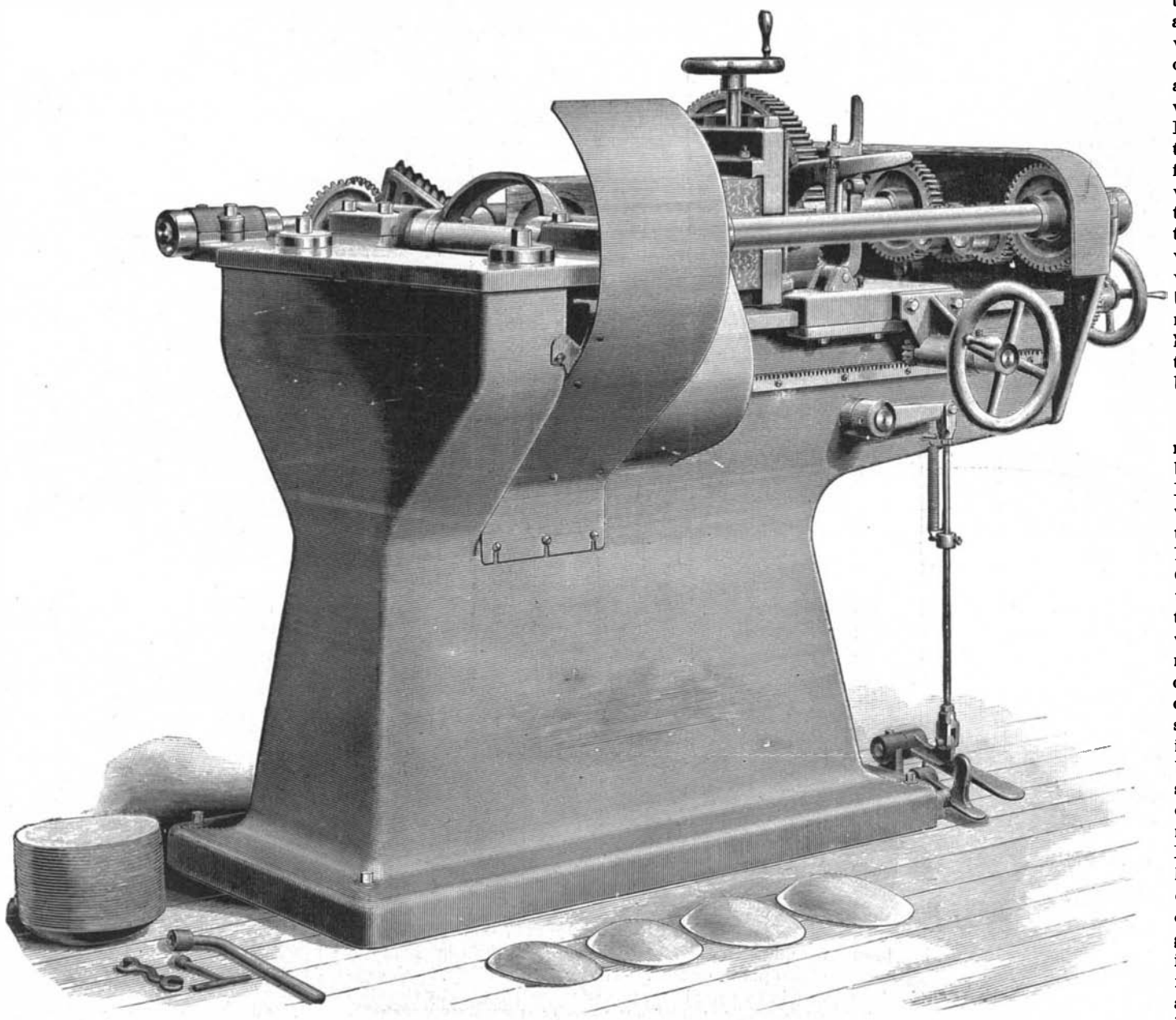
The carriage by which the wood block is held is gibbed to the main frame and fitted with a powerful chuck which grips the block. The chuck is opened and closed by a hand-wheel and screw to receive blocks of different sizes. A screw extending through the frame is connected with a quick opening and closing nut to engage and disengage the feed. When the nut is opened, the carriage can be moved horizontally in either direction by rack and pinion, which is used to save time in moving the carriage forward when commencing the cut or moving the carriage back after the last dish has been cut ready for the next block.

The screw-feed is driven by cut gears and is automatic. After the block has been placed in the chuck the carriage is fed forward by hand-wheel to the point where the cutting is to begin; and the nut is then engaged with the screw by a convenient hand-lever. When the block is fed forward, each revolution of the cutter produces a dish, until the entire block is consumed. When the last dish is cut, the nut is automatically opened and the feed arrested, so that the carriage can be moved back ready for the next block. The feed can be adjusted for dishes of different thickness and can be stopped at any point while the machine is in motion, simply by lifting the feed-pawl.



THE SPIRAL-GLOBE LAMP DISMEMBERED.

The capacity of the machine is 75,000 dishes per day of ten hours. The material used is generally maple; but any odorless wood can be used of sufficient strength.



A MACHINE FOR FORMING OVAL WOODEN DISHES AUTOMATICALLY.

The Study of Rivers.

Great attention is now being given in Germany to the problems caused by the flow of rivers, and an extensive experimental station called the "Flussbau Laboratorium" has been set up at Dresden in connection with the great technical school of that city. It is under government control, and was founded with the idea of bringing scientific methods to bear upon the flow of rivers. A large room is set aside in the basement of the Dresden Technical School, and here, elevated some 4 feet above the floor, is an iron trough or tank 7 feet wide and 2 feet deep, reaching the full length of the room. At the upper end of this trough a large tank is placed with appliances for permitting the water which it contains to flow into the trough in any required volume, so as to exactly imitate the even flow of a river. The trough is filled with sand, and the course of the river is laid out at angles down the trough through the sand, and various experiments are tried. The banks are protected by small bags of shot. The water flows at a certain speed, and the places where the bottom is washed out can be easily studied. The sand, which is carried mechanically by the water, is run over ribs, behind which the sand is deposited. The water is then pumped back into the tank.

Sand of various colors is used for showing the exact position of the deposit of the sand wash in the rivers. This affords an easy means of determining the rate of erosion and deposit. The effects of freshets, or the sluggish flow of dry autumn, can be imitated at will. New channels can be produced artifically by a sudden flushing of water. Dams, breakwaters, piers, docks, bridges, etc., can be built and the effect noted when the water is turned on. The sand washed out of the trough can be caught by the tin ribs, gathered up and measured; the quantity of water being known, it is a simple matter to determine the amount of sand carried per cubic foot. The tank can then be cleared of sand and gravel and stone substituted, thus giving another class of phenomena. With the aid of maps and contours, various sections of more important German rivers can be laid out. Prof. Engels, the director, duplicates every curve, builds every crib and breakwater, and then turns on the water at the ordinary rate of flow of the river under investigation.

According to The New York Sun, a miniature stretch of the Elbe has just been completed, and the cribs are all accurately placed and their banks are held in place with bags of shot. After the water was turned on, Prof. Engels showed how bars were built up and when the channels were deepening, where hollows were being filled in, etc. He was then able to determine where a new crib might serve to preserve a deep channel and at the same time cause the river to deposit its sand in shallows, and where the river might well be filled up and add to the usefulness of shore property. In each case where a change was thought to be desirable, experiments with piers and cribs were made to see if they were effective. By this means all of the rivers of Germany can be studied in turn on a small scale at practically no expense, and saving the cost entailed by a great engineering work which proves useless. The special aim of the experiments is to regulate the rivers in such a way that they will keep their own channel clear and deep enough without dredging. It is believed that there is a great future for the work and it is thought that the time will come when all rivers will be regulated by the advice of river experts who have studied in this or similar laboratories.

TEN new style motor cars are to be placed on the Fifth Avenue elevated branch of the Brooklyn Rapid Transit Company's system as soon as they are equipped with the electric motors. One received a trial recently, which seemed to be satisfactory. It is built on lines similar to the cross-seat cars now run on the East New York line, except that each seat holds only one passenger. Aisle room is saved by placing the seats about a foot behind each other at a slight angle.

POULSEN TELEGRAPHONE.

BY SPECIAL PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

One of the most interesting devices exhibited at the Paris Exposition is the telegraphone invented by the Danish engineer, Valdemar Poulsen. The principle of the apparatus will be understood from the diagram, Fig. 1, in which *E* is an electro-magnet of small dimensions, placed in a telephone circuit including the battery, *B*, microphone transmitter, *M*, and receiver, *T*. The poles of the electro-magnet are very near together, with just sufficient space to allow the steel wire, *a b*, to pass; the wire may be drawn forward so as to bring its successive portions between the poles. The wire used is steel piano-wire of about $\frac{1}{60}$ inch diameter, and it advances at the rate of seven or eight feet per second. The arrangement resembles that of an ordinary phonograph in which the wire, *a b*, replaces the wax cylinder, and the magnetic flux between the poles, the stylus. The sound is recorded in the following manner: when the microphone is spoken into or otherwise receives a series of impulses, the electric impulses set up in the circuit cause variations of current in the coils surrounding the electro-magnet, and in consequence the magnetic flux between the poles undergoes a series of variations corresponding to the original sound waves. These magnetic pulsations act in turn upon the steel wire as it passes along in front of the poles, and magnetize it transversely; each part of the steel wire thus preserves its part of the magnetization, which depends upon the strength of the flux at that instant. The magnetic trace upon the wire thus corresponds exactly to the original sound waves. It remains only to reproduce the record; this is done by connecting the receiver to the terminals of the electro-magnet and passing the wire again between the magnet poles, in the same direction as before and at about the same speed. As its magnetization varies from point to point its movement between the poles causes a variation in the magnetic flux and sets up a series of pulsating currents in the circuit, corresponding in form of wave with the preceding, and thus a sound may be heard in the telephone receiver which corresponds to the original.

M. Poulsen had constructed several different types of the telegraphone before reaching the form now shown at the Exposition. With this instrument, the sound as heard in the receiver is very distinct and is entirely free from the disagreeable scratching noises generally heard in the phonograph. The illustration and diagrams, Figs. 2a, 2b, and 3, show the general appearance of the instrument and the disposition of the various parts. A drum about 15 inches long and 5 inches in diameter revolves between two supports fixed to a metal base; at one end of the cylinder is a pulley which receives a cord passing below to the motor. In this case an electric motor is used, connected with the main lighting circuit. The drum is of brass and has a spiral groove in its surface in which is wound a continuous layer of steel piano wire about $\frac{1}{60}$ inch in diameter; the wire makes about 380 turns. The carriage containing the electro-magnet slides upon a rod which extends across between the brackets. The electro-magnet, shown in section in the diagram, has its cores formed of soft iron wire about $\frac{1}{25}$ inch in diameter, surrounded by electro-magnets about $\frac{2}{3}$ inch long, wound with fine wire. The poles are brought near together and the ends are sharpened and slightly curved on the inner surfaces so as to partly embrace the wire. The coils are surrounded by insulating material, which consolidates the whole. The magnet, *M*, is held above the wire upon a support, *S*, and into it is fitted a contact-piece, *C*, carrying a flexible cord for the current. To guide the magnet along the wire by the points alone might injure these, as they are somewhat delicate, and accordingly a guiding arrangement has been provided which consists of a steel knife edge, *K*, fixed to an arm in the rear; the arm is fixed to a brass sleeve, *B*, which slides upon the main rod. In this way, the carriage, which rests also upon the sleeve, is guided by the knife-edge. The arrangement devised by Poulsen to bring back the carriage to the starting point is simple and ingenious. As the cylinder turns the carriage is thus guided to the end of its course; at this point is fixed an inclined plate, *S*, carried on an arm, seen also to the left of the illustration. The projecting piece, *T*, of the lever, *H*, strikes the plate and the magnet carriage is tilted back in the direction of the arrow; the lever then engages with a catch, *E*. It will be seen that if the carriage is now moved to the right, the rear arm, *A*, will be lifted by the weight of the carriage around *R* as a center. This causes the button, *R*, to engage with a wire, *P*, which is wound spirally around the rod, *O*, and as this rod is revolved by a pulley the carriage is brought back to its starting point. The chain, shown at *L*, serves to hold the magnet off the wire when not in use.

In order to reproduce conversations with the utmost distinctness, the wire-wound drum must be rather rapidly rotated. Experience has shown that a velocity of 1·64 feet (0·5 m.) per second gives the best results. A conversation of one minute in duration could, therefore, be recorded on 98·4 feet (30 m.) of wire, which is approximately the capacity of the instrument illustrated in Fig. 3. But, for the ordinary requirements of life, this time is far too short. Longer conversations are recorded and reproduced by means of the apparatus shown in Fig. 4, in which a very thin, flat steel ribbon, resembling a telegraph tape, takes the place of the wire. The ribbon, *A*, passes from one roll over a standard mounted in the middle of the apparatus to a second receiving roll. Upon the standard the electro-magnet—not shown in the illustration—is mounted, the two poles of which are arranged transversely to the ribbon. The principle is the same as that of the instrument previously described. Although the layers of the ribbon are tightly rolled in a coil, the magnetism of one layer exerts no influence whatever upon the magnetism of the adjacent layers.

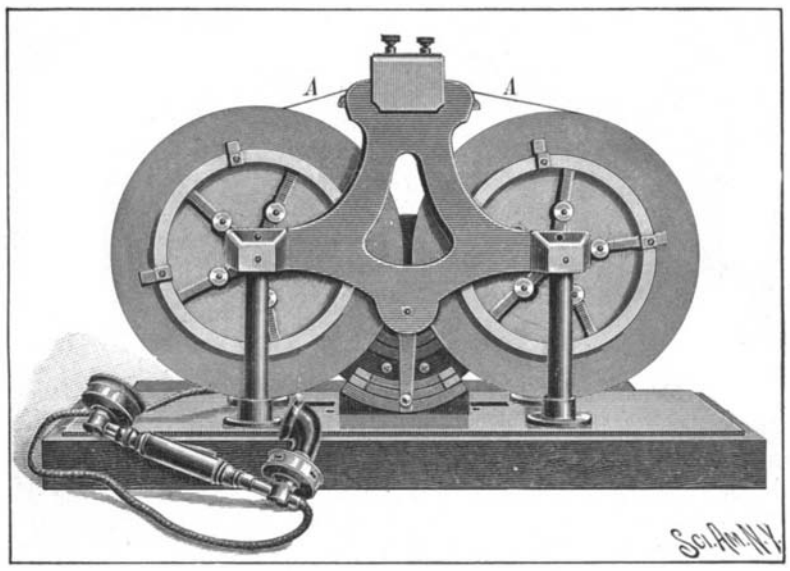


Fig. 4.—POULSEN'S RIBBON TELEGRAPHONE.

A conversation once magnetically recorded can be repeated indefinitely. Experiments which have been made show that a conversation can be reproduced from one to two thousand times without any perceptible diminution in clearness.

To efface the record, it is necessary only to pass a current from a few cells of battery in the circuit of the electro-magnet, when the magnetization of the wire is equalized and it is ready to receive another record. Poulsen recently presented an account of the telegraphone to the Académie des Sciences, in which he explained its principles. He also noted an interesting experiment which has been made by his assistant, M. Pederson, who has charge of the instrument at the Exposition; this is the registering and reproducing of two separate conversations on the same wire. Two electro-magnets are used, whose windings are combined so that each is insensible to the record produced by the other. The first electro-magnet has its windings connected in series, and the second in opposition; under these conditions the records produced by the two magnets may be superposed and separated at will. The superposition of the two magnetic curves has the effect of a resultant in each point of the steel wire, but as one of these components is always neutralized by one or the other of the receiving magnets, it is seen that by using one or the other set of magnets, the first or second series of components may be received, that is to say, the first or second conversation.

The telegraphone is already in practical operation in several telephone stations in Denmark, and by its use telephone messages may be received and kept indefinitely. A subscriber may thus receive messages which have been sent in his absence.

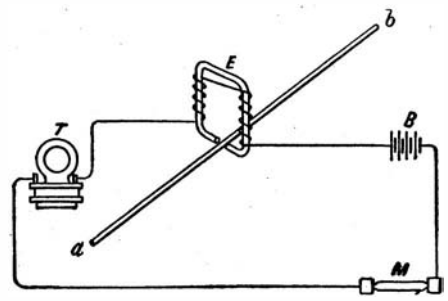


Fig. 1.—DIAGRAM SHOWING PRINCIPLE OF POULSEN'S INVENTION.

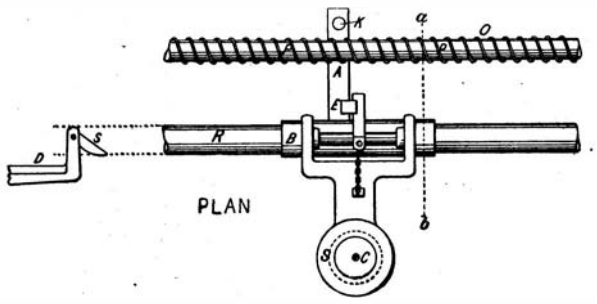


Fig. 2a.—TOP-PLAN VIEW OF THE WIRE-WOUND DRUM AND RECORDING MAGNET.

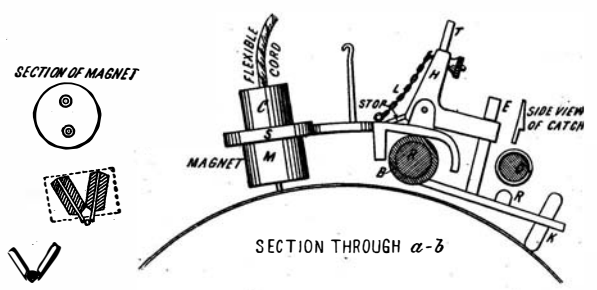


Fig. 2b.—SECTION OF WIRE-WOUND APPARATUS.

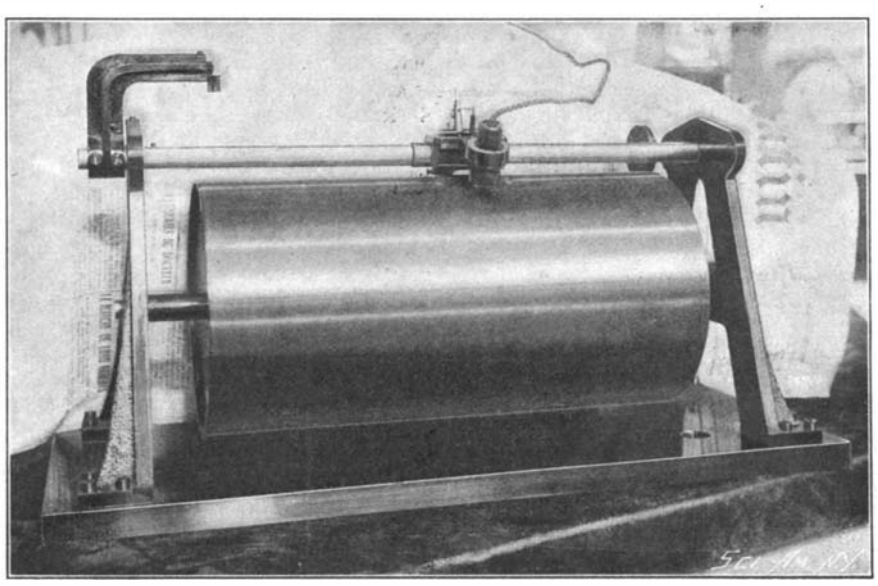


Fig 3.—POULSEN'S WIRE TELEGRAPHONE.

The Majert Accumulator.

A new type of accumulator, designed by Dr. Majert, of Berlin, is coming into use in France, and is now being made by a firm near Paris. In this battery, the negative plates are of the Faure type with lead grid upon which the oxide is pasted; a second form has a grid formed with horizontal projections, which are bent up after the active matter is applied, thus holding it in place. The construction of the positive plate is the main characteristic of the system; it is of the Planté type, being of solid lead upon which a layer of peroxide of lead has been formed; this form is considered as more solid and will permit of discharging at a greater rate, while at the same time a great capacity is obtained; however, to realize these advantages, a great surface must be obtained within small dimensions. The usual method of doing this is to make a plate with a great number of grooves, but this is somewhat difficult in practice. With the plate made by the Majert process, for a battery of one to three hours' discharge, the grooves are about $\frac{2}{3}$ inch deep and $\frac{1}{10}$ inch wide, separated by $\frac{1}{10}$ inch. A plate of this kind cannot be obtained by moulding, and the method of forcing it through a die by hydraulic pressure involves too great an outlay for dies and power. In the Majert process a traveling cutter is used, of special form, which cuts the required groove in the plate; an arrangement is used to take out the shaving perpendicularly at each cut. The plate is placed on a perfectly plane table, and to keep the lead flat a roller passes over it in advance of the cutter. The plate is thus cut on both sides; the tool can make ninety courses in one minute. The arrangement is automatic, and one workman can attend to two plates. To cut a plate having 100 square inches surface requires about ten minutes, making fifty to sixty plates per day.

PROF. HAECKEL, of Jena University, and David J. Walters, a law student, are about to start to find the pithecanthropus. Mr. Walters intends to pursue his investigations in Java and will arrive in that isle before the great evolutionist. The pithecanthropus if found will be of great value, as it will tend to supply the missing link in the evidences of evolution.

Correspondence.

A Tip from an Inventor.

To the Editor of the Scientific American:

Under the heading "Tips for Inventors," the matter in your issue of July 21, 1900, reminds me of a very clever all-round inventor of the name of Alexander Barr, with whom I had the benefit of being intimate while serving my apprenticeship as mechanical engineer in Glasgow, Scotland.

Mr. Barr, or "Sandy" Barr, as his intimates used to call him, styled himself "Inventor for Manufacturers," and had a large clientele of manufacturers who used to come to him with their sorrows, and Barr generally invented some device to help them out.

I was in his sanctum one day, when a large egg shipper called and told Barr he wanted a better way of packing eggs. Barr talked over the existing methods of egg packing with him, and before he went promised to show him something new in that line inside of a week.

After the packer left, Barr turned to me and said, "What would you select in nature to hold an egg?"

"I don't know," said I.

"You would never select a sun-flower, would you?" said Barr.

"I think a tulip would be better, as far as shape is concerned," I replied.

"All right," he said. "Make a three-leaved tulip out of wire, with springs at the base of the leaves for adjustment, and of such a size to hold an egg of ordinary dimensions comfortably."

I set to work under his instructions, and the result was called "The Barr Patent Ovifer." Ovum—egg, and fero—to carry—thus derived.

Three wire tulip leaves were fastened at an angle of 120° on a piece of board, and held an egg very securely.

From the time the egg shipper left Barr's office till we had the first experimental egg holder finished was something like two and a half hours. The holder was subsequently bought by the egg shipper, who paid £250 for it.

Since then I see it has been improved upon by substituting two oval wire leaves, without any spiral spring at the base, but the first idea was gotten from nature. E. A. Suverkrop.

Philadelphia, Pa., August 21, 1900.

THE NEW ERA OF THE AMERICAN SAILING VESSEL.

BY WALDON FAWCETT.

Basing the conclusion on the development of the past few years there is nothing extravagant in the prediction that American sailing vessels will ere long have fully regained their supremacy among the world's wind-propelled craft. Statistics show, to be sure, that the decrease of American sail tonnage has been, during the past few years, proportionately as great as that of other maritime nations, but this is due almost solely to the passing from existence of old wooden hulks, which are now arriving at the termination of their period of usefulness in great numbers. The other side of the picture is vastly different. The problems presented by high priced fuel and other conditions have proved that there is yet a field of work for the sailing vessel, and five- and six-masted wooden schooners and steel sailing vessels are being constructed to meet the new requirements, and doubtless to prove, in their way, quite as successful and profitable as their predecessors.

These new vessels are considerably larger than the clipper ships with which American shipbuilders startled the shipping world about the middle of the century. In fact, most of the steel sailing vessels now being turned out at Bath, Me.—long famous as the home of the clipper ships—are in excess of 350 feet in length, whereas the "Great Republic," the largest of the old clipper ships, was but 325 feet long and carried but 4,000 tons as against 5,000 tons, which is the average capacity of the new vessels. The sailing vessels of recent construction, both wood and steel, have made some wonderful speed records and have easily discounted the performance of that one-time pride of the shipbuilders, the "Red Jacket," which sailed from New York to Melbourne, 12,720 miles, in 69½ days, or the "Sovereign of the Seas," which covered 5,391 miles in 22 days.

It must not be supposed that the sailing vessel of steel construction, or rather metal construction, is an absolute innovation. Early in 1883 there was launched at the shipyard of John Roach, at Chester, Pa., the "Tillie E. Starbuck," a full rigged iron ship, the first metal sailing ship built in the United States and one of the first turned out anywhere in the world. The "Starbuck" was also the first sailing vessel in the world to carry metal masts. She was 273 feet in length, 42 feet beam, and 26 feet depth of hold. She was of somewhat over 2,000 tons burden and cost $150,000. The seaworthiness of the iron sailing ship was early proved by the behavior of the "Starbuck" in a terrific gale around the Falkland Islands, when her iron masts neither broke nor stranded, and the general efficiency of this class of craft is attested by the fact that the vessel in question is to-day trading around the world.

As to whether the lately renewed activity in the construction of sailing vessels is to be permanent or temporary there is a wide divergence of opinion, even among men in the shipping world, and consequently it is equally uncertain whether the steady decrease in the sail tonnage owned in the United States can be stemmed. To present figures showing accurately the extent of this decrease is well-nigh impossible because of the manner in which the governmental statistics are prepared. For instance, whereas there are owned in the United States 13,300 sailing vessels, aggregating 1,825,000 tons burden, in all comparisons they are included with the unrigged craft, such as canal boats, and thus the total appears as 15,891 vessels of 2,388,000 tons. Regarding the iron and steel sailing vessels, the statistics are, however, presented in detail and show that there are owned in America 120 vessels of this class, aggregating upward of 174,000 tons burden. This is about one-eighth the tonnage of the steam vessels of iron or steel construction owned in the country.

The full meaning of the discovery of new usefulness for sailing vessels is in no wise better attested than by a glance at the condition of the shipbuilding industry on the coast of Maine—long the center of this branch of the industry. Shipyards which had been closed for years have been re-opened during the past twenty-four months and other plants have been improved in equipment and materially enlarged. In 1890 there were completed at Maine yards vessels aggregating almost 75,000 tons burden, but the industry gradually declined until in 1897 the total output was but 5,000 tons. In 1898, however, the revival set in and the year closed with a showing of almost 30,000 tons. The total passed the 50,000 ton mark for the calendar year 1899, and during that year the port of Bath alone turned out almost 40,000 tons.

Indeed, the port of Bath has, since the renewal of activity, regained the first rank among the shipbuilding centers on this side of the Atlantic. During the fiscal year which ended June 30, 1899, Bath built more merchant tonnage than any other customs district in the United States, and moreover she built more tonnage of this character than was turned out in any entire State of the Union, save Maine. Only three districts in the United States turned out more than 20,000 tons. The showing is as follows: Bath, 43 vessels, aggregating 46,693 tons; Philadelphia, 37 vessels, aggregating 37,625 tons; Cuyahoga (Cleveland, O.), 13 vessels, aggregating 34,467 tons. Bath is also, in proportion to population, the leading ship-owning city of America, there being 12 tons of shipping per person owned in that city.

The steel sailing ships, which are, of course, by far the most interesting of all the craft of this character, have all been built by the firm of Arthur Sewall & Company, of Bath. The Sewall yard was first established in the first quarter of this century, and since the launching of the brig "Diana" in 1823 more than a hundred vessels have been turned out. About six years ago the Sewall yard was transformed to a plant for building steel ships, and the "Dirigo," the first vessel of this class which they completed, bore the distinction of being the first steel sailing vessel ever built in America. The steel for this initial vessel was imported from Glasgow, but the material for the later vessels has been secured in America. The "Dirigo" has already made some remarkably speedy voyages.

The steel sailing ships "Erskine M. Phelps," "Arthur Sewall," and "Edward Sewall," which followed the "Dirigo" from the yard of Sewall & Company, are each upward of 3,000 net tons burden. In general design all three are practical duplicates. The "Arthur Sewall" may be taken as a fair example. She is 354 feet in length over all, 45 feet beam and 25 feet depth of hold. When loaded she draws about 22½ feet of water. The whole construction of the vessel is strong and rigid, and she will fully meet the requirements of any of the classification societies. She is a two-decked vessel, and both the lower and main decks are continuous, extending throughout the entire length of the vessel. The main deck is plated throughout, and the lower deck for about 200 feet amidships.

Two commodious steel deck houses are provided. One is 46 feet in length and the other 26 feet, whereas each has a width of 18 feet. In the former, which is located forward, are the crew's quarters, consisting of twenty berths, the galley engine and boiler room and coal bunker. The other deck house, located amidship, contains six rooms for the petty officers, and a carpenter's shop. In the poop, aft, is a large, handsomely furnished cabin for the captain. Here, also, is the dining room, and adjoining it the main saloon. Opening off the main hallway also are the officers' staterooms and lavatories and bath-rooms. On the poop deck above is still another house, with accommodations for several passengers. The "Arthur Sewall" will carry 5,000 tons dead weight on the draught above mentioned. She has a neat sail plan and each of her four masts is 100 feet or over above the main deck. The lower masts and topmasts are of steel in one length. Some of the spars are also of steel, including the three lower yards on each mast. The vessel cost over $150,000 and is sailed by a captain, four mates, engineer, sail maker, cook, steward, twenty seamen and eight boys—thirty-seven men in all.

The "Edward Sewall," the fourth and last of the steel ships to be turned out up to date by the Sewalls, is only slightly larger than the ship "Arthur Sewall" just described, but is thus entitled to rank as the largest steel sailing vessel ever built in America. She also is shipentine rigged and is 355 feet in length, 45 feet beam, 28 feet depth and 23 feet draught. She is a two-decked vessel with poop and forecastle and two deck houses for the crew and donkey boiler. Her lower mast and topmasts are of steel, each in one piece, and measure 110 feet above deck. The vessel carries a total of thirty-four sails and cost over $160,000.

The wooden sailing craft have in their recent increases in size fully kept pace with the development which has characterized their steel prototypes. When it was proposed to build a five-masted schooner as a successor to the three- and four-masted craft which had been in service for many years previous to 1898, the suggestion was laughed at in many quarters. Nevertheless five-masted vessels were constructed and proved a success. The same prophecies of failure greeted the plan, later, to construct a six-masted schooner, but the fall of 1900 will see the entrance into commission of the first latter class of carrier.

The pioneer five-masted schooner was the "Nathaniel T. Palmer." She is 285 feet in length, 44 feet beam and 22 feet deep, and spreads 10,000 yards of canvas. A vessel which, when she went into commission early in 1899, was the largest fore and aft schooner ever constructed for ocean service, was the five-masted craft constructed by H. M. Bean, of Camden, Me., for Capt. J. G. Crowley, of Taunton, Mass. A number of capitalists are interested with Capt. Crowley in this large vessel which cost $90,000, and the vessel men who have been talking of the speedy decline if not total disappearance of wooden sailing vessels have had some difficulty in reconciling with their theories the fact that such men as Henry W. Cramp, of the large Philadelphia shipbuilding firm, are among those who have put money in this and other similar ventures.

The five-masted schooner constructed at Camden, Me., is 318 feet in length, 44 feet beam and 21½ feet depth. The spread of canvas aggregates 10,000 yards and the vessel will carry 4,000 tons of coal on a draught of 23 feet. The frame of the vessel is of Virginia oak, and the planking inside and out of Georgia pine. There are five Oregon pine masts, each 112 feet long. The diameter of the foremast is 29 inches, while each of the other four masts is 28 inches in diameter. The vessel is lighted throughout by electricity and heated by steam, and has all the latest improved equipments, including steam steering gear and two 6,000-pound anchors. Like a number of other large schooners of this class, she is engaged in the coal trade between Philadelphia and New England ports.

The five-master had scarcely been completed ere Capt. Crowley opened negotiations with Mr. Bean for the construction of a six-masted schooner, and work on this monster craft was commenced in the autumn of 1899. The vessel, which will cost when completed $100,000 and will have a capacity for carrying 5,500 tons of cargo, will be ready to enter service late in the summer of 1900. The huge schooner is 330 feet in length, 48 feet beam, 22 feet depth of hold, and will draw 24 feet of water when loaded. Her lower masts of Oregon pine are each 116 feet long, and her topmasts are each 58 feet in length. Wire rigging will be used exclusively and four commodious houses are provided on deck. The pumps on the vessel are capable of throwing 1,000 gallons of water per minute, and the chains and anchors are exactly the same size as those placed on the new battleship "Kearsarge."

Perhaps the subject of the new era dawning for American sailing craft should not be dismissed without a word regarding the increased attention which the Navy Department is devoting to training ships. The remodeling of the "Hartford" has lately attracted considerable attention, but of far greater moment is the new training ship "Chesapeake," lately completed at the yard of the Bath Iron Works, at Bath, Me. The "Chesapeake" is the first sheathed vessel built in this country, and the only sailing vessel that has been built for the United States Navy since the sixties. The ship, which is full-rigged, is 225 feet in length, 37 feet beam, has three decks and 16½ feet draught and 1,200 tons displacement. She will spread 20,000 square feet of canvas.

The Meeting of the Association of Official Agricultural Chemists for 1900.

In harmony with the vote of the executive committee, the seventeenth annual meeting of the Association of Official Agricultural Chemists will be held in Washington, D. C., beginning Friday, November 16, and continuing over Saturday and Monday, 17 and 19, or until the business of the association is completed.

The authorities of Columbian University have extended the courtesy of the University lecture hall for the various sessions.

Science Notes.

A factory for liquid air is being erected at Los Angeles, Cal., for refrigerating purposes.

The monument to Lavoisier, erected by international subscription, was unveiled at Paris, July 27, in the presence of a large number of scientific men.

The superintendent of Yerkes Observatory, G. W. Ritchie, has recently perfected a device which renders it possible for astronomers to use the ordinary visual telescope for photographic astronomy. The device consists of a color screen that can be adjusted to the lens of a powerful telescope, thus adapting it for photographic use.

Among the American firms which received the "Grand Prix" at the Paris Exposition was the Smith Premier Typewriter Company, for their machines. The Prix was awarded at the highest rating of the jury, the machine leading all the others as regards the number of points allowed. "Jessop's Steel" was also awarded a Grand Prix. The firm's exhibit was much the same as that made at the Chicago World's Fair. The famous tool steel has taken over twenty highest exhibition awards. The Jeffrey Manufacturing Company, of Columbus, O., have been awarded a gold medal at the Paris Exposition for their elevating, conveying, and mining machinery.

At a recent meeting of the Société Française de Physique, M. Henri Villard announced that he had succeeded in giving a radio-active property to bismuth, by submitting it to the action of cathode rays in a Crookes tube. The best result is obtained by taking the metal as the anode, and the regions which are most exposed to the action of the cathode rays are found to be the most active. The experiment may also succeed by using the bismuth as the cathode, and in this case the region from which the rays depart is found to be the least active. Lastly, the bismuth disintegrated and carried to the walls of the tube is also radio-active. The activity communicated to the bismuth by an experiment which lasted about one hour is very feeble, and is quite inferior to that of uranium. It is nevertheless sufficient to permit of verifying by photographic means the fact that the rays from the bismuth will traverse black paper or aluminium, or the two together. This action appears to be permanent, for at the end of a month it had not appreciably diminished.

The color reaction of Klunge, obtained by the addition of cupric sulphate and sodium chloride solution to an aqueous solution of barbaloin, has been regarded as characteristic of aloin. E. Léger finds, however, that the red color developed is not due to barbaloin at all, but to the accompanying iso-barbaloin; pure barbaloin obtained by repeated recrystallization does not give this reaction, but the iso-barbaloin thus separated gives an intense violet-red color. Léger goes further, and employs the reagent of Klunge to purify barbaloin from its accompanying iso-compound, heating the aloin with solution and collecting the crystals which separate on cooling. In this way an aloin is obtained which ceases to react with Klunge's solution, and is, according to the author, pure barbaloin. When recrystallized from methylic alcohol, it is of a paler color than the impure aloin; it gives no color reaction either with Klunge's reagent or with HNO_3. Its triacetyl-tricloro-compound melts at 164 8° C. The author is examining Cape aloes, which he finds to contain barbaloin, as well as another aloin differing from those hitherto described by him.—Comptes Rendus.

The Rev. J. M. Bacon, of England, has invented a dot and dash system for the purposes of signalling from a balloon, and has recently been carrying out some interesting and exhaustive experiments from the car of a balloon, to endeavor to establish communication with the earth beneath. He ascended, in company with two other aeronauts, to a height of 2,000 feet. Suspended at the end of a wire, some 300 feet below the car, was a large cracker, such as is employed in pyrotechnic displays. This cracker was fired from the car by the passage of an electric current. The aeronauts observed the flash and then timed the seconds that elapsed before the echo was heard. About five seconds passed and then reverberating rolls of thunder were distinguished, lasting some twenty seconds. The noise, owing to the clear, rarefied atmosphere at that height was deafening. The balloon, at a height of 6,500 feet, then drifted over Aldershot, and attempts were made to communicate with the military camp beneath. Slung below the car was a concertina-shaped contrivance, controlled from the car by strings. These were suddenly jerked in a manner similar to that in which a telegraph operator actuates his key, and loud, intermittent sounds were transmitted from the instrument. Owing to the tendency of sound to travel upward, some time elapsed before the signals reached the earth below, and then the soldiers transmitted their replies by means of the heliograph. Once the communication had been established, no difficulty was experienced in the transmission of the signals. The aeronauts, however, were puzzled somewhat in reading the bright heliograph flashes at that altitude, owing to the flashes following each other somewhat rapidly.

Engineering Notes.

There are 120 firms in Germany engaged in the acetylene industry. Most of the burners are made at Nuremberg. There are no less than 26 small towns in Germany lighted by acetylene gas. The first plant of this kind for lighting small towns in Germany was erected at Hassfurt, a town of 2,500 inhabitants.

The United States monitor "Wyoming" was launched on September 8, at the Union Iron Works, San Francisco, Cal. The event was made a feature of the semi-centennial celebration of California's admission into the Union. Little more than the hull of the "Wyoming" is finished, but work is being pushed forward rapidly.

For some little time the air cars on the Twenty-eighth Street and Twenty-ninth Street cross-town lines of the Metropolitan Traction Company, of New York city, have not been in use, and the old horse cars were resurrected. Now, however, the rails on these streets have been replaced by heavier ones, and a new roadbed is being built. When the work is completed, the horse cars will be taken off, and new and heavier air motor cars will be substituted. In the new cars the heaters are much larger than in the old ones, and the machinery lies low down in the truck, thus giving great stability to the car. A number of new cars have arrived in New York, and are being tested on the Eleventh Avenue tracks. The storage battery cars on the Thirty-fourth Street line are run in considerable numbers, and the service is fairly satisfactory. At places there seems to be some difficulty in starting the car when there is a heavy load.

It has long been known that wood dissolves in concentrated acid, and that the solution on further dilution and boiling passes into dextrose. One could not start with diluted sulphuric acid, however, as then by-products would form, which prevent the isolation and subsequent fermentation of the dextrose. Alexander Classen has, however, now made the observation that ordinary chamber acid may be applied under certain conditions, and the observation has a more general interest. If one part of sawdust is mixed with ¾ part of acid of 55° or 60° Baumé, a greenish mass results, which, on extracting, does not show any sugar. But when we compress this mixture, the reaction begins, and a good deal of dextrose is formed. The pressure is kept on for half an hour, until the mass has turned dark and hard. Four parts of water are then added, and the broken-up pulp is boiled for about twenty minutes to complete the inversion. This method thus avoids the necessity of having to use concentrated acid, and there is, further, a saving in acid. The resulting dextrose is described as very good.

Fuel is now being manufactured in London out of mud, street refuse and sewage, for sale to the poor. A chemical process has been invented by which all this waste material is so treated that it is rendered combustible. Mud has been withdrawn from the Thames at Millwall, treated chemically and compressed in briquettes, that in appearance closely resemble blocks of dull ebony or bog oak. This mud has been proved to have a calorific value of 7·52 pounds. It burns readily, exhales a minimum of smoke, and leaves only 25 per cent of firm ash. The street sweepings are mixed with a small percentage of cheap chemicals, pressed into blocks, and sterilized by being subjected to an intense heat of about 400° Fahrenheit. This fuel produces great heat, burns freely with little smoke, and leaves very little ash. The sewage when subjected to this chemical process and pressed into briquettes looks like the best coal, so deep and rich is its sable character. This last fuel can be manufactured at the low cost of two dollars per ton, and is equal in every way to the cheaper coals. Licenses have been granted to manufacture the fuel from these hitherto waste materials, and works are shortly to be installed upon the river's banks at Barking.

Montan wax is one of the distillation products of lignite, which Von Boyen now seems to have obtained in a fairly pure state. The raw material can be prepared in two ways. The lignite is heated moderately and slowly, and steam of 250° C. is passed through the retort; the product, carried over with the steam, melts at about 70° C. Or the lignite is extracted with benzene or mineral oil, when a black or brown mass is obtained. When this raw material is again heated up to 300° C. and treated with steam of 250° C., a crystalline yellow substance results, which was, so far, the best Montan wax known. It resembles paraffin, but is very easily saponified. With potassium chloride it forms a salt, which, dissolved in ligroin, yields a fairly pure substance, melting at 84°. At any rate, redissolution in alcohol, and distillation over acetate of magnesia, does not raise the melting point any higher, and the analyses which Von Boyen made agree pretty well with the formula $C_{29}H_{58}O_2$. The wax would thus essentially represent a fatty acid of an exceptionally high order. Von Boyen calls the acid cerotinic acid. Its occurrence seems to be restricted to lignite. The acid can be distilled without undergoing decomposition, which is noteworthy, considering the 29 carbon atoms in the molecule.

Electrical Notes.

Consul Hughes reports from Coburg, July, 1900: In the Mittheilung des Vereins für Local und Strassenbahnwesen will be found an interesting paper giving details as to the way in which goods traffic is managed in three German cities—Gera, Frost, and Spremburg. They are not large places, but industrially very active, especially in textiles. The power used on the tramways is electricity or steam; the goods are transferred at the station onto smaller trucks, or the railway cars are taken over the town lines. At Frost there are three morning and three afternoon deliveries. At Gera perambulator cars, with flangeless wheels apart from guide wheels, have been tried with indifferent success. All these plants have been worked with a profit for several years, and though people have grumbled, the utilization of tramways for the goods traffic has points which cannot be dismissed without due consideration.

While the new Electric Railway in London is working smoothly and without the slightest hitch, the Undergound Railway in Paris is experiencing many vicissitudes. There have been several accidents, fortunately unattended with any loss of life. The other day recorded a veritable chapter of disasters. First the current broke down, and the train had to stand still in the tunnel for about an hour and a half. A little later the first carriage of a train running from Vincennes to the Porte Maillot caught fire at the Bastille Station, through a spark from the electric motor. The woodwork blazed merrily for about a quarter of an hour, but the company's servants succeeded in subjugating the fire. In the evening another and more serious accident occurred, also at the Bastille Station, through the derailment of the end carriage of a train. There was a panic among the passengers, of whom about ten were bruised and shaken.

According to The Electro-Technical Gazette, German electrical works show great increase. On March 1 last, there were in operation 652 electrical works, against 489 the previous year. One hundred and twenty-two works were in progress of construction, of which 17 were to be ready for operation on July 1. Twenty-seven of all the works were completed before 1890; all the others were constructed within the last ten years. The number of places with electric light exceeds that of places illuminated by gas—900 against 850. The largest electrical plant is at Rheinfelden, with 12,360 kilowatts. Then follow one at Berlin, 9,230 kilowatts; one at Hamburg, 7,290 kilowatts; one at Munich, 6,110 kilowatts; two others at Berlin, of 5,452 and 5,312 kilowatts, respectively; one at Strasburg, 4,955 kilowatts; two others at Berlin, of 4,676 and 4,655 kilowatts, respectively; one at Chorzon, 4,310 killowatts; one at Frankfort, 4,152 kilowatts; one at Dresden, 3,580 kilowatts; one at Stuttgart, 3,208 kilowatts; and another at Hamburg, 3,150 kilowatts. All the electrical works supplied last year 2,623,893 incandescent lamps, 50,070 arc lamps, 106,688 horse power for electromotors, etc.

Polyphase alternate current machinery, which has been so much used on the Continent and in America, is slowly making its way into England. It has already been introduced to a small extent in coal mines. The polyphase motor was worked out in the first instance, because, when the early electric lighting stations for towns had been laid down, it was found that while those which had been installed with alternate currents could distribute energy very conveniently, they were at a great disadvantage in the matter of power supply. The alternate current motor of those days was like the gas engine; it was necessary to run it up to a certain speed to get it into synchronism with the current it was to make use of before it would work, and hence would not start without special arrangements. So a machine was designed into which two currents, each alternating, followed each other at intervals of a small fraction of a second, producing a magnetic field, which revolved, and which dragged a properly designed armature after it. This was followed by a motor, in which three currents followed each other in the same way. Diphase and multiphase generators were also designed to generate the currents in succession, as required. The great feature of the polyphase apparatus, so far as coal mining is concerned, says The Colliery Guardian, is the fact that the motor has no commutator, and no brushes bearing on it, and breaking circuit. There is, therefore, no sparking in the same way as there is with the continuous-current motor. For starting purposes, however, the machine requires the insertion of a resistance in its armature circuit, in order that the starting torque may be sufficient, and this necessitates the addition of slip rings on the shaft, similar to those through which the current is taken from the alternating current machine. The resistance is gradually removed as the motor gets up speed, just as the starting resistance of the continuous-current motor, and is entirely cut out when the motor is in synchronism. It is possible for sparking to take place at the contact between these rings and the conductors, but the chance is never so great as with the continuous-current motor commutator.

PARIS EXPOSITION—AUSTRIAN PALACE.

The Austrian Palace is next to that of the United States in the group of national buildings facing on the Seine. It represents a type of architecture which prevailed in Austria during the eighteenth century, known as the "Barocco" style. The portico above the main entrance has two columns on each side, and above the balustrade rise a corresponding pair of pilasters supporting the roof-cornice; on either side of the portico is a narrow window, with ornamental iron work, having in front a richly ornamented vase. The main façade has also a very handsome fountain on each side, which adds greatly to the effect; the upper basin, surmounted by a sculptured group, is of shell-form, and from this the water falls into a large basin below. On the sides and rear of the building the lower windows are semicircular form, surmounted by grotesque heads; above, a series of pilasters rises to the upper cornice. The roof is bordered by an ornamental balustrade, interspersed with trophies, with the Austrian eagle on each corner; in front, upon the cornice, is seen the national coat of arms. Ornamental shrubs are placed around the building; in the front is a handsome balustrade at the edge of the quai, with a large group at either end. The sub-structure consists of several arches of solid construction, ornamented with grotesque heads.

GRAND STAIRCASE, PALACE OF AUSTRIA, AT THE PARIS EXPOSITION.

A flight of steps leads to the main vestibule; on each side is a piece of ancient tapestry, in front of which is a large bronze bust. That on the left represents the Emperor Francis I., and that on the right the Empress Maria Theresa; both busts were executed by Messerschmidt, in the eighteenth century. A second flight of steps leads up to the main rotunda, from which rises the handsomely ornamental staircase, shown in the illustration, leading to the upper story. To the right of the main rotunda is a circular reception room, richly ornamented and furnished; the mantel is in carved onyx and the central table has a top in polished onyx five feet in diameter. The room contains a fine marble bust of the Emperor Francis Joseph, surrounded with ornamental plants. The corresponding room to the left is finished in Empire style, with mahogany panels rising to the ceiling. It has a frieze in oil, representing allegorical subjects, and contains two paintings by Austrian artists. On one side of the rotunda are two cases containing manuscript music of Beethoven, Mozart, and other musicians; here are also a number of fine bronzes, including an equestrian figure of the Emperor Leopold I. in antique bronze. In the rear is a handsomely furnished room containing views of Vienna; the corresponding room on the right contains a collection of the headings of all the principal Austrian journals, arranged in cases, and also a collection of ancient newspapers; one of these, the "Diarium" of Vienna, dates from 1758. On the right side of the rotunda are a number of cases representing the postal and telegraph service of the Austrian government. In one of these are seen various models of city letter boxes, pouches, marking stamps, etc., and models of different types of postal wagons. Another case represents the telegraph instruments used, showing keys, Morse registers, cables, batteries, etc., and a third case contains telephones and cables. Opposite is a Hughes printing telegraph with electric motor. A large room in the rear is devoted to the exhibits of mineral waters of Austria, with views and photographs.

The rooms of the upper floor open into the rotunda by a series of arches; those in the rear contain a collection of paintings by Austrian artists; in another room is seen a silver plaque offered to the Emperor Francis Joseph by Arthur Krupp on the occasion of the Jubilee of 1898, and a gold writing set presented by the Emperor to General de Beck, chief of the Etat Major. Another room contains a collection of wearing apparel, embroidery, arms, and other objects from different regions, including two life-sized figures representing inhabitants of the Ragusan district.

Kelp Burning in the Hebrides.

The manufacture of kelp from seaweed was at one time an important source of revenue in the highlands and islands of Scotland. Large quantities of it were required in the last century for the manufacture of soap, glass, and alum. The introduction of barilla from Spain has resulted in a great falling-off of the industry, which would have probably declined entirely if it had not been for the discovery of iodine, which saved the kelp trade from extinction for a time, but finally iodine was obtained in large quantities from Chile as a by-product of sodium nitrate, and this succeeded in materially decreasing the commercial value of kelp. Kelp was formerly made of two kinds of weed, the fuci and the laminaria. Kelp is now made entirely from two kinds of driftweed, of which "tangle" is less susceptible to deterioration than the other varieties. It is torn up and driven ashore during the winter gales. It is collected and stacked in heaps usually on foundations built of stones rounded by the action of the waves. It is arranged so that air will have free access to the heaps.

The burning usually begins in May, provided there has been no wet weather, and continues during the summer months. The kilns are made of sods or stone, and, according to The English Mechanic, vary from 12 to 20 feet in length, and from 2 to 3 feet in breadth, and 1 foot in depth. They are usually built on a plot of grass and are fed with the dried weed which yields about a fifth of its weight of kelp. The fuel is placed in the kiln and the seaweed is spread lightly over it. The seaweed is stirred constantly until the kelp is in a semi-fluid state, glowing like molten metal. It is then allowed to cool, and when taken out of the kiln appears as a hard, heavy substance of a dark gray color. It is then broken into pieces of suitable sizes and it is shipped to market. In Norway the kelp is burned to ash and it realizes its full value.

The Movement of Swiss Glaciers in 1899.

Prof. Forel, Prof. Lugon and Herr Muret have just completed a report upon the movement of the glaciers in Switzerland during last year. Seventy-three glaciers in all were observed; in ten cases there had been an advance, and in sixty-three cases a retreat. The tendency of glaciers to diminish is thus rendered evident. The glaciers which had increased in 1898 remained stationary in 1899. The only Swiss glacier which manifests a steady and certain increase is the Glacier de Boveyre in Canton Valais. The two Grindelwald glaciers, which until recently were decidedly stable, have begun to decline. The lower Aar glacier, which remained stationary until 1893, has now retreated 75 feet. On the Eiger glacier, for the first time since it was measured, a diminution was observed; it has retreated 230 feet. Out of thirty glaciers observed in the Valais twenty-two have shown a decided retreat during the year, three a probable decrease and only four an evidence of increase.

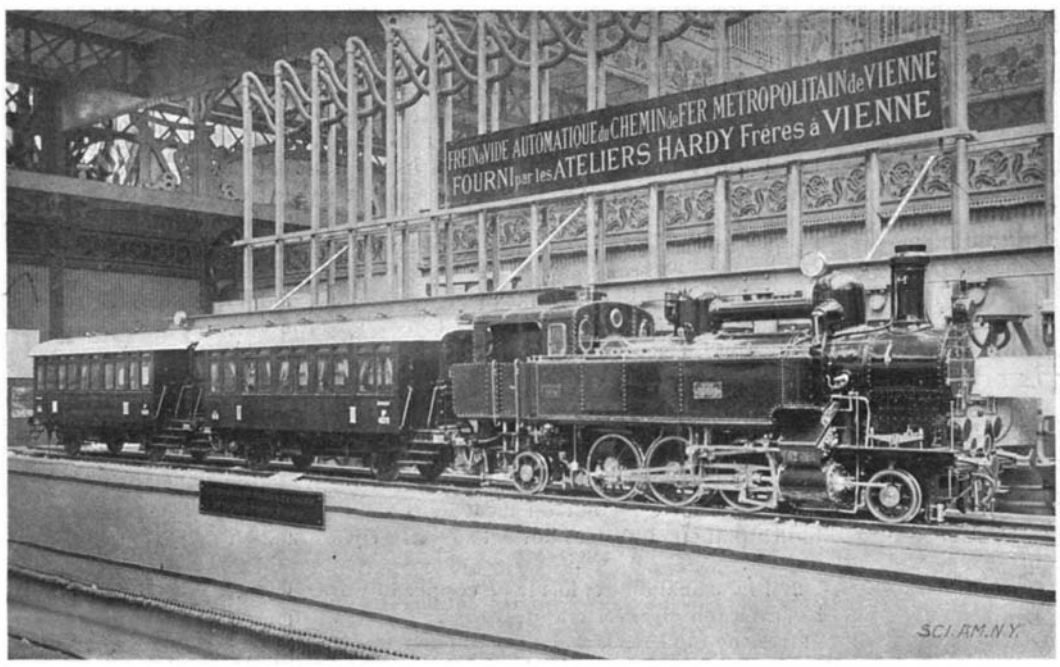
THE PALACE OF AUSTRIA, "STREET OF NATIONS," PARIS EXPOSITION.

THE first trip over the third-rail line of the Albany and Hudson Railway, of Hudson, N. Y., was made on August 20. Power for operating the road was obtained from the company's new water-power plant at Stuyvesant Falls, and the test was satisfactory in every respect. It is stated that a speed of 60 miles an hour was made at times.

MODELS IN AUSTRIAN SECTION OF THE PARIS EXPOSITION.

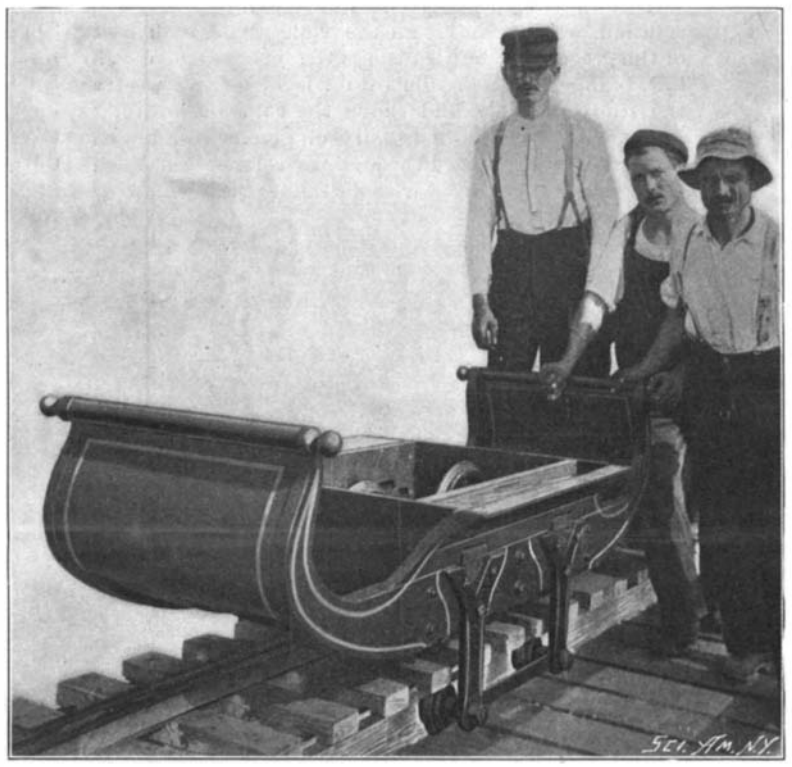
In the civil engineering section of the Paris Exposition are to be seen a number of models showing the public works which have been carried out in different countries of Europe. The Austrian exhibit contains two models of this kind, which illustrate a series of improvements lately inaugurated in Vienna. The first of these is the Metropolitan Railway system, which is now practically finished. For several years the need of a rapid transit system was felt in that city, and a number of projects were studied. The Emperor Francis Joseph, in his annual discourse of 1891, expressed the wish that the affair might be carried out in the near future. This led, in fact, to active preparations on the part of the government. The idea of the Metropolitan was not only that of transportation within the city limits, but also to make connection with the suburbs, even those at some distance; it was to be used for freight transportation and to supply the city with provisions. With this in view, the work was carried out on a large scale. The line is double track throughout, with an extensive signal system. Two large main stations have been erected; the first of these is at Heiligstadt, on the Francis-Joseph line, and the second at Hütteldorf-Hacking, on the West line. The system includes four different sections, which have a total of about 16 miles. The first is a suburban line which passes from Heiligstadt to the western part of the city and thence to the suburbs. The Belt line, the second, runs parallel to the first as far as Nüssdorf, then skirts the city to Gumpendorf, joining the lines of the Vienna valley and that of Vienna-Trieste. The third section, that of the Vienna valley, leaves from Hütteldorf and follows the river to the Custom House, with a junction to the Praterstem Place; it makes connection with the Vienna-Warsaw and other main lines. The last section is that of the Danube Canal, starting from the Custom House station; it follows the canal to Heiligstadt, with a branch line to the Belt railroad. The first three of these lines are now completed and the fourth is to be finished next year. The construction was carried out with great difficulty and expense, owing to the nature of the ground to be passed over and the necessity of satisfying the different conflicting interests, but the work of the first three lines was finished in the beginning of 1897. According to the configuration of the ground to be passed over, the line is in some places elevated, and in others it runs in a tunnel or cut. The elevated portions are generally supported upon a viaduct, and it is only in a few places in the outlying districts where it runs on an embankment. Over certain wide streets metal bridges have been constructed; these are ballasted to deaden the sound.

In the illustration will be seen a well-executed model of the locomotive and train used on the Metropolitan. The road has been laid out under conditions which differ considerably from those of a main line; the grades reach two per cent and the stations are very near together. It is necessary to provide heavy locomotives, having great tractive power, sufficient adherence and capable of going around sharp corners. As will be noted the locomotive has three pairs of driving wheels and a front and rear truck; it has no tender, the supplies being carried upon the locomotive; its design is in general that of a modern type of European heavy locomotive, with all the recent improvements. In order to decide what kind of train it was best to use, the committee examined the systems in use at present in Berlin, London, Liverpool and New York, and came to the conclusion that the cars used on the New York Elevated present the greatest advantages, the stops being but fifteen seconds, while at Berlin and London, where compartment cars are used, the stops are thirty seconds. Accordingly the American type of car was adopted. The train is made as short as possible, the first-class cars being suppressed. A system of vacuum brakes, manufactured by Hardy Brothers, of Vienna, is used. The trains run from 5:00 A. M. to 11:00 P. M., and when the system is entirely finished, the interval between trains will be from 3 to 6 minutes, with 12 minutes on the Belt line.


FREIN à VIDE AUTOMATIQUE du CHEMIN de FER METROPOLITAIN de VIENNE
FOURNI par les ATELIERS HARDY Frères à VIENNE
SCI. AM. N.Y.

MODEL OF LOCOMOTIVE USED ON VIENNA METROPOLITAN ROAD.

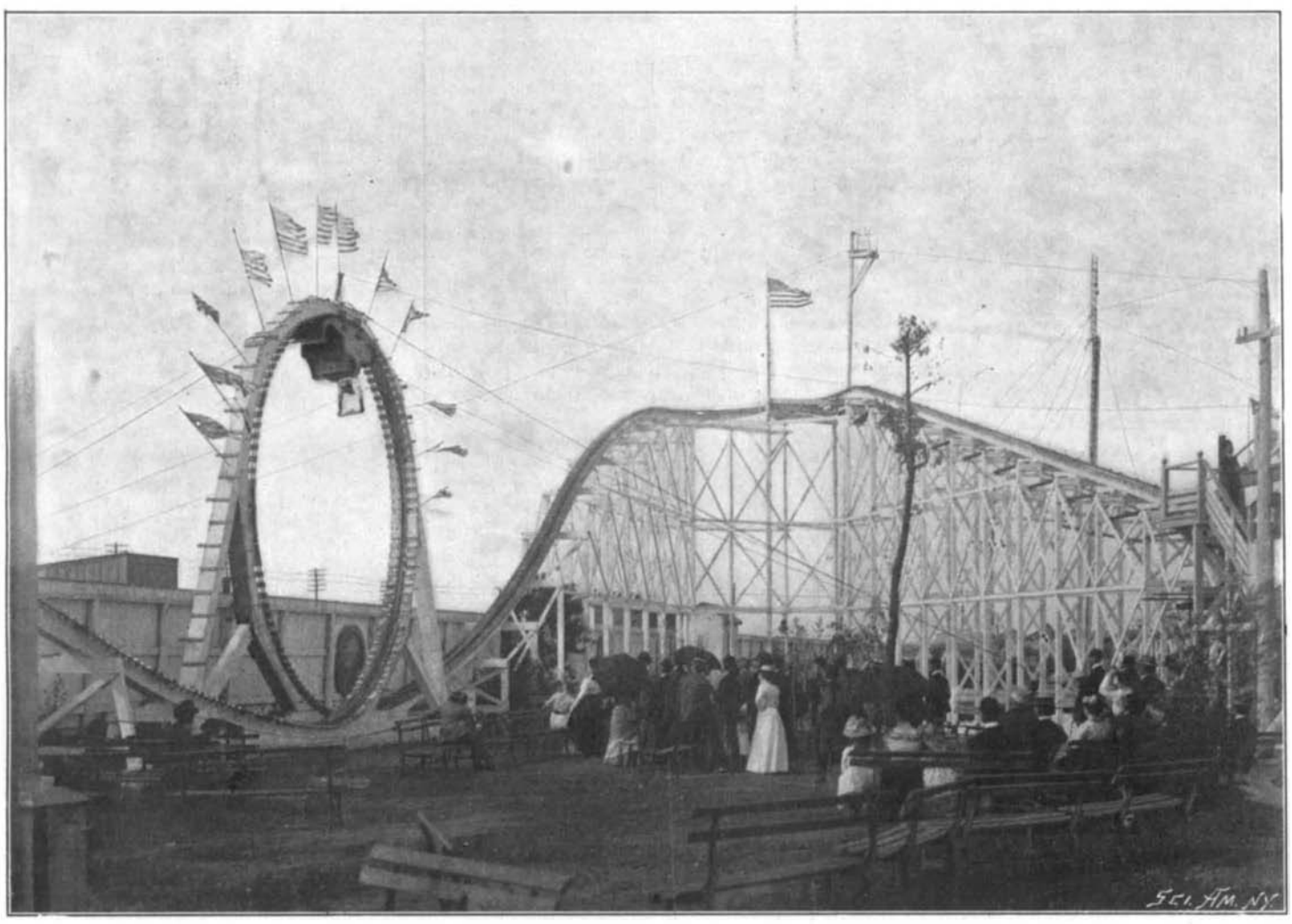
The erection of the various stations of the road was carried out in consultation with one of the leading architects of Vienna, M. Otto Wagner. Besides the two main depots of Hütteldorf and Heiligstadt and that of the Custom House, are those of Gersthof, Hernals and Ottakring, for passengers, and that of Michelbeuern for market products. There are numerous way-stations upon all the lines. At the main stations five or six platforms are provided, one for each line; they are joined by underground passages in most cases. For the lines below the level, the superstructure is relatively light, and contains only the different offices; for the overhead lines a structure of much larger size is erected.



A VIEW OF THE CAR.

CONEY ISLAND'S CENTRIFUGAL RAILWAY.

That discoveries and inventions of great scientific importance are often applied to the purpose of contributing to the pleasure of the amusement-seeking public is proved clearly enough by the mechanical toys and scientific curiosities sold in the shops of our large cities. One of the most remarkable of such applications of scientific methods, remarkable chiefly for the size of the apparatus employed and for the curious phenomenon presented, is to be found in the Boyton centrifugal railway, which has been added to the attractions of Coney Island. It can be safely said that those who have ridden in one of the cars of this odd road of Boyton's have been very strongly impressed with the meaning of the term "centrifugal force."

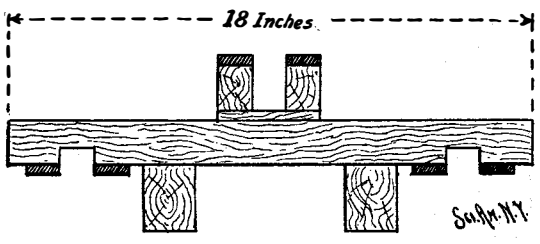


THE BOYTON CENTRIFUGAL RAILWAY, SHOWING THE CAR AT THE HIGHEST POINT OF THE LOOP.

The railway consists of an elevated inclined track curving upward and downward near its middle to form an oval loop, the vertical or major axis of which is 24 feet long and the horizontal or minor axis 20 feet long. The cars used are 6 feet long by 3 feet

wide, and are supported by two driving wheels 1 foot in diameter, arranged in tandem to run upon a single central rail on the upper surface of the ties. Four auxiliary wheels 6 inches in diameter, running upon two rails secured to the under surface of the ties, are also employed. When in motion a car retains the upright position exactly as would a bicycle, the auxiliary wheels being used only to steady the car when the velocity is very small.

The highest point of the railway is 35 feet from the ground; and between this point and the beginning of the oval loop is a stretch of track 75 feet in length.



CROSS SECTION OF THE TRACK.

The car is hauled up by a cable to the point of maximum elevation and is then cut loose. With a constantly accelerating speed it plunges down the incline of 75 feet, dropping a distance of nearly 35 feet in this brief interval, whirls around the loop, and reaches the station after running up a heavy grade, whereby its speed is considerably reduced. So great is the velocity of the car when it reaches the end of its downward plunge of 75 feet, that, at the highest point of the oval, it is held against the track in opposition to the force of gravity, by the centrifugal force alone. If a bucket of water be swung around at arm's length not a drop will be lost, provided the motion be swift enough. And the passengers in the car can no more fall headlong from their seats than the water in the whirling bucket.

The six-inch auxiliary wheels running on the under rails would prevent the car from falling when it reached the top of the oval. But such an accident, even without the auxiliary wheels, could hardly occur, since the centrifugal force is always greater than that of gravitation.

A representative of the SCIENTIFIC AMERICAN who rode in the car stated that although a chain was stretched across his body while seated in the car to hold him in, in case of accident, at no time during the ride was he brought in contact with the chain, but that at all times he felt himself held firmly in the seat by centrifugal force alone.

The "Deutschland" Again Breaks the Eastward Record.

Each successive trip of the "Deutschland" seems to carry with it a new record. The most memorable ocean voyage, so far as speed is concerned, was that of the "Deutschland" and the "Kaiser Wilhelm der Grosse," which left New-York September 4, in close company, and for a considerable portion of their voyage were in plain sight of each other. Although it was not a race in name, it was in fact. The "Kaiser Wilhelm der Grosse" left an hour earlier than the "Deutschland," and the latter overhauled and passed her, and made a record passage of five days seven hours and thirty-eight minutes, the average speed being 23 36 knots, and she would probably have done better had it not been for the fact that in the first day's run there was a moderate sea and a slight fog. The succeeding days she logged 535, 540, 549, 545, and 306 knots. The "Deutschland" beat the "Kaiser Wilhelm der Grosse" by five hours and twenty-seven minutes between the Sandy Hook lightship and the Lizard. The previous record of the "Deutschland" was five days eleven hours and forty-five minutes, consequently the eastward transatlantic record was lowered by four hours and seven minutes.

THE Princess of Wales has presented to the London Hospital the wonderful apparatus which has been employed in Copenhagen for the cure of certain intractable skin diseases by means of light. As is well known, it is the chemical rays—the blue, violet, and ultra-violet—which exert this curious beneficial effect. To use the apparatus the patients simply lie on couches, while the light of the sun, or, failing that, the rays from an electric arc lamp, are focused upon the affected part of the skin. To obviate the heat which is always generated by focusing the sun's rays in this manner, the rays undergo concentration and cooling by means of a curious "reversed telescope." The rock crystal lenses, which are impervious to heat rays, inclose a column of distilled water. The patient is submitted to this treatment for about an hour at a time, but the treatment being quite painless, not the slightest inconvenience is experienced, and the operation has been proved to be eminently successful.

KHAKI neckshields are now worn in sunny weather by the London police force.

COLOR SCREEN FOR TELESCOPES.

The color screen for improving the definition of refracting telescopes, recently invented by Prof. T. J. J. See and Mr. George H. Peters at the United States Naval Observatory, has already led to discoveries of the highest interest. This apparatus consists of a small cell containing fluid through which the light of the stars passes in reaching the eye. The cell is attached to the eyepiece of the telescope, as shown in the figure.

The fluid used in the cell is deadly poisonous, and so corrosive that if a drop of it were to get into the eye, total blindness would follow. The scientists use the following mixtures, each of which has its advantages:

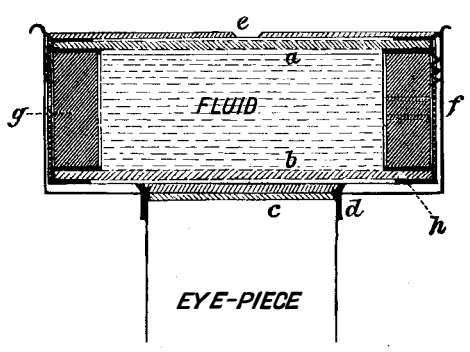
1. Bichromate of potash, dissolved in water, which is a brownish solution. This removes the blue halo which usually surrounds the stars, but allows the outstanding halo of reddish light to pass through. This fluid performs very well on most of the stars and the bluish planets, but does not act so perfectly on reddish objects.

2. Picric acid and chloride of copper in water, which has an intensely green appearance. This solution removes the blue rays, and also the red ones, very perfectly, while the green and the yellow are transmitted as if the fluid were perfectly transparent. This is the best combination yet made and yields splendid results.

3. Chromate of potash dissolved in water; this is very good for most objects, but it has not yet been used so much as No. 2.

4. Chromic acid dissolved in water, an intensely red solution, which removes all the violet, blue, and most of the green rays, but transmits the yellow-green, yellow, orange, and red. This fluid is of especial use in the study of Mars, and shows the canals beautifully sharp. The canals are usually of greenish or bluish color, and when viewed through the color screen, filled with chromic acid, appear as dark lines on a yellow or reddish background.

Prof. See has only begun his work on Mars, but it will be continued through the coming opposition of the planet in February next, and doubtless some important additions will be made to our knowledge of Mars, which of late has attracted so much attention.



The illustration gives a vertical section of the cell; *e* is the aperture for the eye; *a* and *b* the two parallel planes of glass confining the fluid; *g* the ring of glass upon which the plates rest; *h* thin rings of rubber inserted to make the joint tight; *f* two small holes in the ring of glass, by which the cell can be filled after the case is screwed down with the metal cap; *c* is the head of the eyepiece, and *d* a brass collar holding the cell on to the eyepiece.

All these researches on the color screen grew out of Prof. See's discovery, October 10, 1899, of some faint belts on Neptune, when the atmosphere about Washington happened to be quite smoky from West Virginia forest fires, and the smoke of the sky cut off the blue light like a color screen in the tailpiece of the telescope. It then occurred to him to construct an artificial cell which would reproduce the condition which accidentally arose from the smoke in the air, and he and Mr. George H. Peters then constructed the first color screen ever applied to a telescope. The color screen removes the blue halo about the planets and allows the astronomer to measure the diameters more accurately than has hitherto been possible. Prof. See has been hard at work all spring and summer on the diameters of the planets and satellites, and already has results which will add no little to the fame of the Government Observatory. The diameter of Neptune has been found by previous astronomers to be about 35,000 miles; the measures made with the great equatorial of the Naval Observatory indicate that the real diameter is nearly 8,000 miles smaller, or 27,190 miles.

In the case of Uranus the diameter is diminished from 34,000 miles to about 28,500 miles. Saturn has his diameter diminished over 1200 miles; while that of Jupiter is reduced some 300 miles.

Venus has been subjected to elaborate investigation, and the diameter found to be 7,553 miles, with an uncertainty of only ten miles.

This is probably the most exact determination of the diameter of a planet ever made, except that of the earth, which is found by geodetic measurement within about a quarter of a mile; and shows what future investigation with color screens will do for exact astronomical measurement.

In the case of Mercury, Prof. See finds a diameter of only 2,460 miles, which is about 570 miles smaller than the received value. This indicates that the planet nearest the sun is in reality very little larger than our moon, which it resembles in many respects.

This new determination of the diameter of Mercury has led Prof. See to adopt a new value for the mass of this planet which has heretofore been in great doubt among astronomers. The Government astronomer thinks he has new evidence that the mass of Mercury is one fifteen-millionth that of the sun, which is only one-half that generally used among scientists.

A Simple Photographic Printing Paper Formula.

A photographic printing paper which closely resembles platinotype has been recently used in Belgium. To prepare the sensitizing solution, the following formula is used:

Water	100 parts.
Ferric oxalate	15 "
Oxalic acid	2 "
Nitrate silver	3 "

These proportions should be kept as indicated; if, for instance, more than three parts of nitrate of silver is used, the image will lack detail in the shadows and the half-tints will be wanting. The printing of the paper is carried out in the same way as for platinum paper; that is, until the image is well distinguished upon the sensitive surface. After printing, the paper is placed in a developing bath composed as follows:

Water	100 parts.
Borax	6 "
Tartrate of soda	6 "

The ingredients are dissolved, and a few drops of a 20 per cent solution of bichromate of potash are added; if more bichromate is used, the image will be hard and full of contrast; and if less, the image will be gray and feeble. A certain latitude is thus obtained, and negatives of different intensity may be provided for. After development, which lasts five or six minutes, the prints are washed for a few minutes in running water and then toned in the following bath:

Water	1,000 parts.
Chloroplatinite of potassium	1 "
Chloride of sodium	10 "
Citric acid	10 "

The prints are placed in the bath until they have reached the desired intensity. They are then fixed in a two per cent solution of ammonia; the fixing lasts about ten minutes, after which the prints are well washed as usual.

The Yellow Invasion.

From time to time our French contemporary, Le Monde Illustré, devotes an entire number to such subjects as a hypothetical war, in which the Chauvinistic tendency of the French press to magnify the deeds of their countrymen is very manifest. The issue of August 25 is given up entirely to "La Chine et l'Europe en l'an 2,000," by that versatile writer, M. Henri de Noussanne. Such fictions as these, while not particularly novel at the present time, are quite suggestive, especially as we are now actually menaced by the yellow peril. The author goes on to describe how the empire of China waxes strong under Japanese leadership in the year 2,000. A quarrel finally arises and the European ambassadors retire; there is discord between the Powers, and some torpedoes are exploded in Hong Kong Harbor. The result is the commencement of war on the largest possible scale. The success of the Chinese is immediate, and European women and children are sold as slaves. The most formidable naval battle in history follows, and the Chinese march upon Russia as an objective point. Siberia is conquered; the Chinese win a battle at Moscow, and all Europe has a panic, and, finally, Germany is occupied. Then follows an account of a thrilling battle on the Rhine. Atmospheric electricity is put into service by the European artillerists, science thus coming to the rescue of the overwhelmed Europeans, causing the Chinese to flee. The Chinese troops were immediately set upon by the remains of the armies of the allies, their communications were cut, and for six months Germany, Austria, and Asiatic Russia were inundated with the dead and dying Chinese. A great naval battle also takes place, in which the maritime power of the Chinese was broken. Japan was definitely separated from China. Europe organized for the universal welfare and took for its device that of industrious Belgium, "*L'Union fait la force.*"

The Benzine Risk.

In most printing offices benzine is used to wash the ink from type. Some weeks ago a boy in such an office, while handling a can of benzine, set it down with unusual force, causing some of the benzine to fly out; it fell on a gas stove, and this resulted in serious damage to the printing office, but fortunately no one was injured. It is surprising that more accidents of this nature do not occur. With the use of such an inflammable and explosive substance as benzine the greatest precaution should be used, and in no case should any benzine or naphtha be used for cleaning or other purposes in a room which has any light or fire, except, of course, the electric light.

REBUILDING NIAGARA'S RESERVATION BRIDGES.

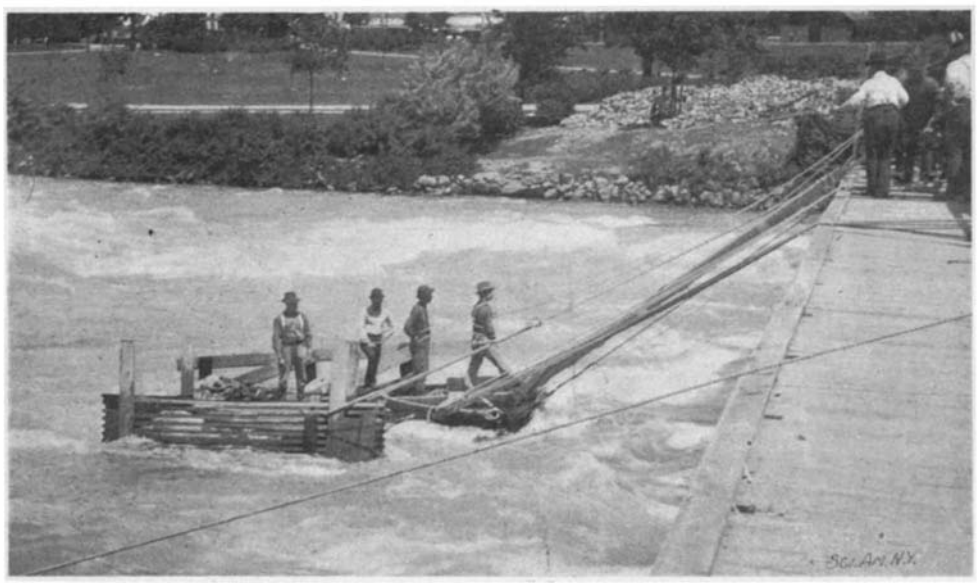
During the last session of the New York State Legislature the sum of $122,000 was appropriated for the construction of new bridges to connect the mainland with Green Island and Green Island with Goat Island at Niagara Falls. This is a part of the State Reservation at the Falls, and the site of the bridges is right through the upper rapids not over 500 feet back from the brink of the American Fall. In due time the commissioners of the State Reservation, who have charge of the expenditure of the appropriation, awarded the contract for the work to W. H. Keepers & Company, of New York, who are now engaged in carrying out the provisions of the agreement.

This piece of bridge construction is unequaled for interesting conditions by any similar work ever carried on at Niagara, a locality rich in interesting features of bridge erection. It is made worthy of considerable attention by the mere and remarkable fact of its location so near to a precipice of the height of the American Fall, and right in the midst of the upper rapids, where the current runs all of 30 miles an hour. The distance back from the Fall, and the speed of the current, are only too suggestive of the probabilities of death for any of the workmen who might, by accident, plunge from the bridges into the water. Then the fact that these tumultuous waters are to be spanned by concrete bridges is an important feature. The placing of a concrete arch over quiet waters is a task requiring engineering skill, and doubly true is it when a 30-mile current and a maximum depth of 11 feet of water are to be encountered.

This new concrete arch, to connect the mainland with the island that is termed Nature's Temple, will be the fourth bridge built on the river near the site. It was in 1817 that the upper rapids were first spanned by a bridge, which was carried away that winter. With the coming of spring in 1818 another bridge was built, and in 1855 the third bridge was thrown across the riotous waters. It is this last bridge that will give way to the concrete arch. The old bridge was an iron structure resting upon three piers in the river, and there is every reason to believe that the style of the concrete bridges will do much to add to the beauty of this already magnificent section of the State Reservation and river. The design selected is in keeping with the general plan to beautify the locality about the Falls, on which so much progress has been made since the State took possession of the lands in 1885. No work yet done in beautifying the lands has cost so much as this individual step in bridge erection, and it is but continuing the improvements, so praised by all, on truly magnificent lines.

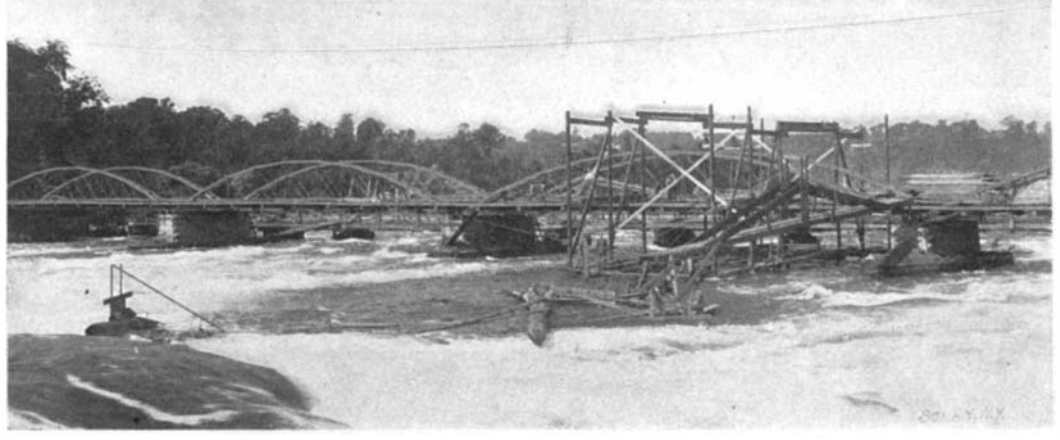
The work of building the new bridges naturally forced a suspension of all carriage traffic to Goat Island, but pedestrians have been provided with a means of crossing by a temporary bridge erected below the old bridge between Green Island and the mainland, and by another temporary bridge erected above the old bridge between Green Island and Goat Island. These temporary bridges are about six feet wide. They are formed of frame trusses resting upon rock-filled cribs or piers.

The length of the bridge between the mainland and Green Island will be 371 feet, and in this length is included the finishing panels. There will be three spans. The end spans will have a length of 103½ feet, while the center span will be 110 feet long. The rises of the end spans will be 10 feet and that of the center span 11½ feet. The piers will have a width of 13½ feet and a length of 53½ feet. On the upstream end the piers will have a granite nose or ice breaker. The width of the roadway will be 20 feet in the clear, and on each side of it will be granitoid walks 9½ feet wide. The length of the bridge between Green Island and Goat Island will be 198 feet, including the finishing panels. This bridge will also have three spans. The length of the end spans will be 50½ feet and that of the center span 55 feet. The piers will be 8 feet wide and 50 feet 5 inches long. They will also be fitted with granite ice breakers. The roadway and walks will be identical with those on the bridge above referred to.



WORKMEN PREPARING A FOUNDATION FOR A NEW BRIDGE AT NIAGARA, WITHIN 500 FEET OF THE AMERICAN FALLS. LIFE-LINES ATTACHED TO THE WORKMEN.

The structure is to be stone-faced throughout, and it is expected to have it completed before winter sets in. To accomplish this, work will progress night and day. The mixers and pumps are operated by electric motors. The piers for the arches will be built in cofferdams surrounded by shields in order to break the force of the current and keep the water out. Life lines and buoy rafts are stretched along the work or float where deemed necessary for the safety of the men engaged on the work. A cableway has been stretched between the mainland and Green Island to facilitate operations, while derricks will handle the material for the bridge from Green Island to Goat Island.



BUILDING ANCHORAGE IN THE RAPIDS FOR THE COFFERDAM.

BUILDING A TEMPORARY BRIDGE TO GOAT ISLAND.

Balloon Accident in Paris.

A curious balloon accident occurred in Paris a short time ago. A throng of people had gathered at Vincennes, just outside the Machinery Annex of the Exposition, to see the balloon ascension. The aeronaut did not start promptly, owing to the high wind which was blowing at the time. The crowd was disappointed, and began to hoot and jeer him. This demonstration caused Captain Mouton, the aeronaut, and his assistant, to give the order to let go. The balloon rose above the housetops, and a sudden gust of wind blew it over and bumped the balloon against telegraph and telephone wires. Ballast was thrown out, and the balloon rose a little, but the wind blew it against the roofs of the houses, and it knocked over a chimney and tore away several window shutters. The car was caught in the network of telegraph wires, which caused a short circuit, and a spark lighted the balloon. This started a panic, as all knew that an explosion must ensue.

The aeronaut opened the safety valve of the balloon, but he was too late to prevent the explosion. There was a report like a cannon, and the correspondent of The New York Times stated that the balloon looked like an immense pear-shaped vessel hissing and smoking, with a blaze that was perceptible all over Paris. The upper floors of one house caught fire, which added to the horror of the accident. The assistant succeeded in coming down by the aid of wires and poles, and was quite badly burned by the flames. Captain Mouton, in trying to cut the car away from the body of the balloon, became entangled in the cords and was burned and bruised, though not seriously hurt. It was two hours before the firemen could get the flames under control.

Inclined Stairways for the New York Elevated.

An inclined stairway or ramp has been built at the Fifty-ninth Street Station of the Third Avenue Elevated Road, with a view of adopting it on a majority, if not all, of the stations of the road. It is of the Reno type, which we have already illustrated. The time has arrived when the traffic is so heavy on the elevated and the stairways are so narrow that some means must be employed for raising the passengers to the level of the platform. Both the elevator and the inclined stairway will be fully tested before anything definite is decided upon. When the roads are equipped with electrical power it will be a very simple matter to put in motors at each station to run either an inclined stairway or an elevator. The inclined stairway now in use has a capacity of three thousand passengers per hour. The receipts at the ticket offices have already increased since the new improvement was introduced.

A New Gutta-percha.

The English acting-consul for Zanzibar reports the discovery of a new gutta-percha. This substance is derived from a tree which grows principally at Dunga. When tapped with a knife, a white fluid emanates, which, when placed in boiling water, coagulates into a substance which in character bears a very striking resemblance to gutta-percha. As the material cools it becomes exceedingly hard, but while soft it can be moulded into any required shape. The fruit of the tree resembles a peach in shape, but grows to the size of a small melon. Experts have experimented with this new product to see if it in any way possesses the qualities of gutta-percha, and although it is not expected to prove equal to the genuine article, it is considered that it will be quite suitable for some purposes for which gutta-percha is at present utilized, and it will thus become a marketable article. It is said to abound in Zanzibar, and will be a very cheap product.

Automobile News.

Mr. John Brisben Walker ascended Pike's Peak, Col., September 8 by an automobile. He did not go to the very top, but made an ascent of 11,000 feet, thus making an automobile record. The road was in very bad condition or the top would have been reached. The descent was an exciting one.

A steam vehicle belonging to a Newport resident was recently put in the stable at night, and the owner neglected to turn off the fuel supply. Steam was generated rapidly, and the safety valve blew off at intervals. This continued until all the water in the boiler had evaporated; a fire then started, and the machine was rendered worthless.

At a meeting of the Executive Committee of the National Association of Street Railway Employés, held at Detroit, Mich., September 7, the president was instructed to draw up a plan by which local unions are to be assessed in order to raise a fund with which to purchase automobiles for use by the street railway men in the cities where strikes are in progress.

The Emperor William of Germany has now become a devotee of the automobile. It was constructed under the instructions of the German War Office, and after completion was carefully examined by two engineers from the Daimler manufactory at Stuttgart. The automobile weighs thirty-two hundredweight, and is propelled by a benzine motor capable of imparting a speed of sixty miles an hour, and the vehicle cost $9,000.

The Greater Inter-State Fair of Trenton, N. J., which will be held September 24 to 28, will have some interesting automobile races. The Automobile Club has accepted the cup which the Trenton Fair Association has tendered to the club for a road run from New York to Trenton. A motocycle race of 10 miles has also been added to the programme. All the floor space originally assigned to the Automobile Exposition Department of the Fair, comprising 25,000 square feet, has been taken, and the erection of an annex is in contemplation. The entries for the race close on September 20.

Consul-General Guenther says: On July 25 the motor factory of Oberursel, near Frankfort, exhibited in the presence of a number of experts its new alcohol plow locomobiles. The plow locomobile is a 20 horse power one, and confidence is expressed by competent judges that coal can in some cases be substituted by alcohol, which can be procured everywhere and at a low cost. The alcohol plow is said to have performed its work fully as well as a steam plow operated simultaneously. The problem of using alcohol for power purposes has been solved by the motor factory in evaporating denaturized alcohol of 90°. The construction and operation of the motor is, after this gasification, the same as that of a gas motor. The machine uses about a pint of alcohol an hour for one horse power. It is claimed that the operating expense is 25 per cent lower than that of steam plows.

The question of automobile traction for military service is now being studied in the different armies of Europe. In Germany and Italy especially a number of experiments are being made, and two principal solutions of the problem have been examined. In the first case ten automobile wagons would be used, these being of the normal type, weighing 30 tons, of which 12 constitute the load; the distance to be covered by the automobile is about 47 miles per day. In the second case a large tractor, self-contained automobile, or locomotive with tender would be used, to draw wagons equally of 30 tons, and covering the same distance per day. The main difference between the two systems is that in the first case there are ten motive apparatus to look after, while in the second there is but one. According to circumstances, these two systems have been adopted in several armies. In England two types of automobile wagons are used. The first is an armed automobile used for scouting purposes; this type was constructed during the Egyptian campaign and is adapted to run on a railroad track; it carries a Maxim gun, two officers and one man. The other model is used on ordinary roads and is armor-plated, carrying two Maxim guns and a dynamo which supplies an arc-projector; a device enables the current to be sent into the armor-plate itself, which is a good means of defense when attacked at close quarters. The motor used is of the petroleum type, with electric ignition. As to the lighter automobiles for military use, an increasing interest is being taken in this question. The Emperor William, who has given great attention to the subject for some time past, has just accepted three automobiles from different manufacturers, with the intention of trying them during the grand maneuvers in order to determine personally the services which they may render. The automobile is already playing an important part in the Austrian army, and its efficiency has been tested in the recent military maneuvers. Twelve automobiles have been used for the sanitary service and a great number of motocycles placed at the disposition of the officers. Major-General Maurice followed the cycling maneuvers which were recently held in England, on a quadricycle with petroleum motor of the De Dion type. The opinion as to the service rendered by this vehicle is quite favorable, at least as concerns the transportation of the superior officers at times when combat is not actually engaged.

The Home of the Krupp Gun.

BY C. E. CARPENTER.

A remarkable record of commercial enterprise and colossal industrial development is contained in the annual report for 1899 of the steel works of Friedrich Krupp, the great German ironmaster. Krupp, as is well known, occupies the position in Germany that Andrew Carnegie does in the United States. There is much of resemblance between the two men. Each possesses the wonderful executive ability and tireless energy for carrying out, without heed of odds, the inventions of his active brain. Krupp's millions have been piling up with a speed and steadiness equal to the Pittsburg iron king's, and although his business has grown to a degree the magnitude of which would seem to belie the possibility of further increase, the bounds of his prosperity are by far not yet in sight.

In the United States, the general public's knowledge of Krupp pertains almost entirely to his reputation as a maker of war materials. Few people are aware that his huge steel works turn out every variety of iron and steel products, from railroad trains to machine tools. Cannons and guns form merely a small part of his output. A fair idea of the amount of business captured yearly by the Krupp plant is given by the figures of labor employed during the calendar year 1899. These consisted of no less than 49,679 persons, 3,559 of whom were engaged in the offices alone; 27,462 men were employed in the main steel plant at Essen; 3,475 at the Buckau branch (near Magdeburg); 345 at the Germania shipyards in Kiel; 6,164 in the coal mines and 6,128 at the various ore mines and trial shooting grounds.

One would rightly think the caring for so large a body of men to be a most difficult undertaking. And yet no army is under better management than the men who turn out the grim instruments of war that find their way to every quarter of the globe and deal death to many thousands of all nationalities annually.

The workingmen live in settlements, in dwellings erected for their comfort by their thoughtful employer. At the Essen plant alone Krupp had erected up to the first of April, 1900, 4,853 family dwellings for the housing of his married employes. The houses are rented to the men at a very nominal rate, the firm receiving no profits therefrom and stipulating only that the buildings shall be kept in good condition by the tenants. Besides these homes, there are two large lodging houses for the accommodation of single men, a hospital, two barracks for epidemic cases, a convalescent home, a workingmen's eating house, a club house for clerks, a casino for works' foremen, a housekeeping school for girls, an industrial school for adults with three for children, a library and several minor institutions. The "Wirthshauser" (beer restaurants) are under the direct supervision of the officials, and intoxication is a rare sight among the laborers.

The form of protectorate thus exercised over employes outside of the works, strange as it may seem in this country, causes no friction in the community, Krupp's idea not being to exercise a rigid restraint over his men, but merely to build up their daily life on lines that will in the end prove most beneficial to them. His success in this is amply attested by the general content and cleanliness of the settlement.

Returning to the actual business of the plant, it should be mentioned that the firm of Krupp proper comprises the steel works at Essen and at Annen, in Westphalia; the blast furnaces near Duisburg, Neuwied, Engers and Rheinhausen (the latter possessing three furnaces each of 230 tons capacity per diem); a plant near Sayn; four coal mines near Hanover and shafts at Salzer and Neuack, besides part ownership in various other mines; more than five hundred iron ore mines in Germany, of which eleven are deep borings fitted with mechanical equipment; various deposits near Bilbao, Spain; shooting grounds near Meppen 10 miles in length with a possible firing distance of 15 miles; three ocean steamers; several stone quarries and clay and sand deposits, besides the control and operation of the shipbuilding and machine company "Germania" at Berlin and Kiel.

The principal articles of manufacture at Essen are cannons, guns, ammunition, gun barrels, armor plate and sheet armor for all protected parts of warships, as well as for fortifications, iron and shipbuilding material, machine parts of every sort, sheet iron and steel, rollers, tool steel and scores of other articles, the enumeration of which would occupy too much space here.

The Essen plant is divided into the following departments: 2 Bessemer works containing altogether fifteen converters; 4 Martin works; 2 steel casting works; puddle works; crucible steel plant; welding mill; iron castings works; works for casting guns and brass; glowing rooms; hardening halls; crucible chambers; block rolling mill; rail rolling mill; sheet rolling mill; bolt and spring steel works; spring machine shop; mill press and armor plating rolling mill; hammer works; wheel foundry; open sand and hoof foundries; tire rolling mill; boiler foundry; field railway construction shops; mechanical workshops (with file factory) 4 repair shops; railway machine shops; testing laboratory; 2 chemical laboratories; 1 chemi-physical testing laboratory; shops for construction, mechanics' saddlery and cutting; a boiler house; electrical plant; gas works with one plain and two telescoped gas tanks holding respectively 5,700, 17,500 and 37,500, altogether 60,700 cubic meters; water works with three separate water sources; factory for fire-proof brick and briquettes; brick kiln; lithographic and photographic establishments, together with a book bindery, freight office, telegraph, telephone, fire and safety departments and food supply stores.

The most interesting estimate of the size of the plant, however, is gained from the figures bearing on the consumption of gas and water, the telegraph and telephone lines, etc., inside the works. For example, the consumption of water at the steel plant amounted in 1899 to 15,018,156 cubic meters (49,054,468 cubic feet), or as much as the city of Cincinnati. The combined length of the subterranean water conduits was 107 miles, that in the buildings 66 miles, with 451 hydrants and 604 fire plugs. The use of gas for lighting purposes amounted to 60,708,045 cubic feet (or as much as the city of Leipzig, Germany), the same supplying 2,596 street lights and 41,745 lights in the buildings of the plant. The total length of the underground conduits was five and a half miles; that of the interior conduits 145 miles. The Krupp gas plant is the seventh largest in size in the German empire.

The electrical plant of the steel works possesses three machinery rooms with six distributing stations, eighteen miles of underground and fifty-odd miles of overground cable for lighting, and feeds 877 arc lights, 6,724 small lights, and 179 electro-motors.

As regards means of transportation, Krupp's plant is singularly well supplied; a standard gage railway net is in direct track connection with the Essen railway station, North Essen and Berge-Borbeck. Communication with these three stations is effected daily by fifty complete trains. In all, the net comprises 36 miles of track, 16 tender locomotives and 707 cars; furthermore, there is a narrow-gage railway net with 28 miles of track, 26 locomotives and 1,209 cars.

Even more suggestive than the foregoing are the figures relative to the telegraph and telephone systems connected with the works. Krupp's telegraphic net contains 31 stations with 50 Morse apparatus and 50 miles of wire. It connects with the imperial telegraph office in Essen, and the yearly business between the factory and the city amounts to no less than 22,787 sent and received dispatches. The long distance telephone possesses 328 stations with 335 apparatus and 200 miles of wire, while the daily usage averages 900 to 1,000 conversations.

The fire department is composed of ninety-five men. The works proper contain 347 and the outbuildings 121 hydrants; while in addition there are 35 extra water sources for use in case of necessity, 82 electric fire alarms, besides the 330-odd telephone call stations, the latter being also used for alarm calls.

Lastly the statistics of coal and ore are of sufficient interest to deserve mention. At the mines, an average of 1,877 tons constituted the daily output of ore, while the production of coal in the mines proper averaged 3,738 tons per diem. Coal and coke were consumed at the steel plant to the extent of 952,365 tons—an average of 3,174 tons daily, or eight railway trains of 40 cars holding ten tons each. The total consumption at the remaining works was 622,118 tons, or in all 1,570,483—5,000 tons daily.

The Current Supplement.

The current SUPPLEMENT, No. 1290, has many articles of great interest. The first page illustrates and describes the "Tour du Monde" at the Paris Exposition. "American Engineering Competition—X." deals with stationary engines. The second article on "Mechanical Stoking" treats of the Roney Mechanical Stoker. "The Oldest Library in the World" deals with the wonderful discoveries at Nippur, which are referred to elsewhere. "The Mycenæan House of the Double-Ax" is an interesting archæological article by Louis Dyer. "The Mission of Science in Education," by John M. Coulter, is concluded. "The Coal Trade of the United States and the World's Coal Supply and Trade" is illustrated by a graphic diagram.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

PEA-THRESHER AND CLEANER.—SAMUEL H. WILLIAMS, Barnardsville, Tenn. This machine threshes peas on the vine just as they are mowed and raked in the field, and cleans them with little waste, or breakage. One portion of the concave is adapted especially for cutting the pods from the vines, and the other portion for threshing the peas from the pods. Any pods which may pass through the machine without having the peas removed from them are automatically returned to a portion of the concave and cylinder especially adapted to finish the threshing. The vines are completely separated from the unthreshed pods and shelled peas; and the shelled peas from the pods after the vines, peas, and pods have passed between the concave and the cylinder.

Engineering Improvements.

EXPLOSIVE-ENGINE.—SAMUEL F. BEETZ, Mendota, Ill. The main cylinder has a partition forming separate cylinders. Pistons reciprocate in unison in the cylinders and are connected with the main driving-shaft. A rotary valve is driven in unison with the pistons and has an inlet and an exhaust port arranged alternately to connect the working-chambers with the motive agent and with the exhaust. At the ends of the cylinder are valve-casings, each provided with a chamber leading to the port and connected through valved openings with the motive-agent supply and with the rotary admission-valve, so that the compressed charge from the compression-chamber of one cylinder can pass into the working-chamber of the other cylinder.

Mechanical Devices.

MECHANICAL MOVEMENT.—JOHN SCHIES, Anderson, Ind. The invention provides a novel construction whereby a plunger within a revolving carrier or body is caused to move longitudinally within the body or carrier as the latter is revolved. The device is to be employed in glass-making. The plunger is used on the top and partly makes a bottle or jar in connection with the necessary mold. When this first operation is completed, the carrier is to be turned half-way over, whereupon the plunger will be out of the way, so that air can be applied to allow the next operation to be effected by blowing and the bottle or jar completed.

ROAD-MAKING MACHINE.—SEPTIMUS T. WILLIAMS, Beaver Dam, Ky. The machine requires only about one-half the team power ordinarily employed. It belongs to a class of machines employing a gang of concave disk-shaped plows in connection with a scraper-blade In this particular machine, however, the gang is made adjustable as to the angle of inclination to the line of draft. And the trailing scraper-blade, fulcrumed about a vertical axis on the side opposite the gang, is made adjustable as to inclination to the line of draft to neutralize the lateral thrust of the gang of disk-cutters.

WALL-PAPER TRIMMING, PASTING, AND MATCHING MACHINE.—WILLIAM D. TABER, Cranston, R. I. The trimmed or slit paper after leaving drawing-rollers, passes over an upright table, the printed or ornamental side of the paper being on the table and the back of the paper being in contact with a revoluble brush which serves to apply paste to the back of the paper. The brush receives its supply of paste from the peripheral surface of a fountain-roller, the lower portion of which extends into the paste contained in a receptacle. The trimmed paper with the paste applied, after leaving the table, reaches a traveling apron, by which it is carried along. By providing side-rails with graduations, the operator is enabled readily to match the paper by cutting it in proper lengths.

REVERSING-GEAR.—ELGAN S. SLOAN, Elk City, Penn. This gear, by means of which a pulley or other revoluble member can be driven in either direction consists of a clutch member adapted to engage the clutch member of a loosely mounted pulley so as to turn the pulley with the shaft. In order to drive the pulley in the opposite direction another clutch member is provided, which, when thrown in, turns the pulley in the desired direction by intermediate gearing.

WRENCH. — THOMAS H. BROSNIHAN, Livermore Falls, Me. On the shank a bearing is held, in which a screw-rod, engaging the movable jaw to adjust it on the shank, is held to turn and slide. The screw-rod is turned by a head normally separated from the bearing. A spring is held in opposing recesses in the head and the bearing to move a cheek-piece on the movable jaw into engagement with the work. The wrench can be quickly adjusted to grip the object, especially a pipe, without slipping.

MATCH-MACHINE.—FRANK L. VAN DUSEN, Hull, Canada. This machine is the invention of a match expert. It automatically cuts splints from a wooden block, dips the splints, dries the tips, and then ejects the completed matches. The prominent features are: provision of improved means for intermittently feeding or advancing the endless chain which receives and carries the splints; a construction whereby the vertical traverse of the splint-cutter and connected devices is shortened, the friction lessened, and the rapidity and efficiency of the operation of the machine increased; improved mechanism for effecting the movement of the cutter; an improved form of the sockets for receiving and holding the splints, whereby defective splints are dropped and the perfect ones retained; improved means for pushing up the matches in the sockets, preparatory to ejectment therefrom; improved match-ejecting mechanism; an improved heater for the match composition; and an improved arrangment of composition vats or pans in the heater, whereby removal and substitution or change of the vats may be quickly made, in case one becomes ignited, or other necessity for it arises.

Railway Appliances.

ANTIFRICTION-BEARING FOR CAR-TRUCKS.—JAMES S. PATTEN, 403 Equitable Building, Baltimore, Md. Mr. Patten has, among other things, provided a special construction of the casing of the lower portion of the outer bearing, by which the bearing-casing readily wears off with the ordinary wear of the bearings, thus maintaining a tight fit to exclude dust without interfering with the proper supporting of the weight upon the balls held in the outer bearing. The bearings are provided with a separate socket for each ball, so that the balls will be maintained generally in the desired position and will not roll together by the tilting of the lower bearing portion in one direction or the other.

Vehicles and Their Accessories.

FIFTH-WHEEL.—HIRAM C. FOUTS, Emory, Tex.—The fifth-wheel comprises a turn-table with two circular raceways and series of balls, and a raised series of balls in the middle. The inner series of balls is in a plane higher than the outer one. A ring-shaped plate bears with its under surface on the outer series of balls and at its inner edges against the inner series of balls. A cap-plate bolted to the central boss overlaps the inner edge of the ring-shaped plate. The wheel thus formed is simple, strong, and sensitive.

Miscellaneous Inventions.

JOINT FOR PIPING. — JOHN W. WIGGINS, 118 President Street, Savannah, Ga. The invention is an improvement in joints for plumbing. A tapered ferrule is used provided with longitudinally-extended ribs and an end-flange. The ferrule is inserted in one of the pipe-sections and fitted therewith in the fitting of the other pipe-section. Calking completes the joint. When the connection is completed the joint is perfectly smooth on the inside. The longitudinal ribs prevent the ferrule from turning; while the tapered exterior enables the ferrule to be readily fitted to any size of lead pipe.

ANTISEPTIC BROOM.—OSCAR S. KULMAN, Savannah, Ga. The invention is an improvement on the broom previously patented by Mr. Kulman and described in the SCIENTIFIC AMERICAN for June 24, 1899. The improved broom contains in its straws a bag filled with antiseptic material and supported below the lowest line of stitching by a bow or loop. The arrangement is such that the broom is rendered as flexible as the ordinary broom, which flexibility is extremely desirable, since it allows a slight lateral motion of the antiseptic bag in sweeping, to feed the antiseptic material. The bag when empty can be replenished.

HANGER FOR BATTERY ELEMENTS.—JAMES L. HAYES, Salida, Colo. Wooden hangers become saturated with the oil placed over the top of the solution in a battery jar. Moreover their clumsy structure interferes with free access to the jar when renewing the bluestone or other chemicals. To overcome these objections, the inventor employs a hanger consisting of two intertwisted pieces of wire having a central eye to receive the element and hooked divergent ends to engage the jar so as to hold the parts in place.

PORTABLE CABINET.—CHARLOTTE G. SIMPSON, 59 West 88th Street, Manhattan, New York city. The cabinet is of the portable type used for holding family medicines. It may readily be carried about or held stationary, as preferred, and is well adapted to receive a large number of vials and articles for family use, all disposed in compact order for ready access.

FISH-TRAP.—JOHN O. SHARPLESS, Fairhaven, Wash. The invention is a peculiarly-constructed fish-trap adapted to be set in a body of water and furnished with a lead to cause the fish to enter the trap. The trap may be changed as the tide changes, thus permitting it to be used at all times. The lead, it should be remarked, is entirely flexible and can accommodate itself to all movements.

HYGIENIC BEER-PRESSURE APPARATUS.—CHARLES PETERS, Brooklyn, New York city. The invention provides a new hygienic beer-pressure machine arranged to cool and purify the air before passing it into a barrel or keg, to keep the beer in a natural condition, and to prevent raising its temperature by the compressed air, the beer in its passage from the barrel or key to the faucet being cooled to the desired degree, so that when finally drawn it is in perfect condition.

FORM FOR BOILING MEATS. — FREDERICK A. LANSING, Brooklyn, New York city. In boiling hams it is the common practice to remove the bone before boiling and to tie the meat with strings to keep it in shape. The several steps consume much time and render it necessary to trim off portions of the outer part of the ham. Mr. Lansing avoids these requirements by employing a casing of the general form of the meat, the casing having a longitudinal opening in its upper portion, permitting expansion and contraction. Clamps are provided for drawing the edges of the opening together.

ADJUSTABLE NAILLESS HORSESHOE. — HARRIET R. FENLEY, Dallas, Tex. A tread-plate is employed provided with a superposed hood, both bisected at their front; the tread-sections are hinged together. Upon the tread-plate a wear-plate, comprising two side-plates and a toe-plate, is secured. The hood is fitted on the exterior of the animal's hoof, so that the tread-plate is drawn against the bottom when the hood is in place. All injury is avoided to an animal thus shod.

CIGAR-BOX OR PACKING. — LOUIS and MORRIS BERGER, Manhattan, New York city. The invention provides a simple means in connection with a box to prevent fraudulent refilling or partial refilling with cigars from another box. Arranged in the box are strips of paper attached alternately in pairs at opposite sides of the interior of the box, one edge of each strip being free and each strip being adapted to cover a layer of cigars in the box. As the cigars are sold, each strip is to be torn off, thus indicating that no cigars other than those of the previous layers have been removed.

ADJUSTABLE COMBINED GATE-HINGE AND ROLLER. — GEORGE O. CULVER, Quarryville, N. J. Mr. Culver has devised an ingenious gate which is supported by rollers mounted upon posts. One of these rollers—the main supporting roller—is pivotally mounted, so that the gate, after having been pushed back, can be swung around. The gate can be adjusted vertically to permit the passage of small stock, or in time of winter when snow or ice may clog the gateway. The gate is so nicely balanced that little effort is required to operate it. Cattle cannot interfere with the operation of the gate; and there is but little strain upon the posts.

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References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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(7959) W. E. H. asks: Where can I find particulars for making an electric machine? How much would one cost that has power enough to run the electric top or the electric motor which you give a description of in the SCIENTIFIC AMERICAN of August 11, 1900. A. You will find a full description of a Holtz machine with working drawings quite powerful enough for your experiments in the SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 278, 279, 282, price ten cents each. Besides the details of the machine, many experiments are described, which may be performed with it. Its cost depends entirely upon how much of the work you can do yourself. The materials will cost but a few dollars.

(7960) H. B. S. writes: Some time ago I saw an account of an electrical invention that could be used alternately as a stove or an ice cream freezer, by simply reversing the current. What I wish to know is if it is possible to obtain a low degree of temperature by the electric current, and if so, how? A. We have not known anything of the invention to which this refers. It is, however, possible to produce cooling by means of the electric current. If a current of electricity is sent through a thermo-electric junction in the direction opposite to the current produced by heating that junction, a cooling of the junction takes place. Whether this has been or can be carried to the extent of freezing water we do not know. It is doubtful if it can be done economically.

(7961) P. S. D. asks where was the first electric railroad operated? A. The first electric railroad was from Port Rush to Giant's Causeway, Ireland.

(7962) R. E. asks: 1. Does the substance selenium lose its conductive power for electricity instantly as it is surrounded by darkness? A. The action of light upon selenium is instantaneous. 2. Does it change instantly to a conductor when again surrounded by light? A. Selenium does not become like a metallic conductor when light strikes it. Its resistance is greatly reduced, but is still much greater than that of metals. 3. What is its cost, and where can I obtain it? A. We are not able to quote you the price. Any dealer in chemicals can furnish it. 4. I wish to make two disks isolated from each other, turn in perfect synchronism. Is there any simpler way than the use of an alternating current dynamo for one disk connected with a motor for the other disk? A. You can connect two disks by a rod of insulating material, hard rubber, for instance, and run them together. 5. Where can I procure so small a dynamo and motor, single phase alternating? A. Small dynamos and motors can be obtained from any builder of dynamos.

(7963) D. D. S. asks: 1. Can electric lights be run by batteries which go by blue vitriol? A. A small electric light of one or two candles can be lighted by a copper sulphate battery, but it is a most expensive and laborious mode of obtaining light. 2. Are not a horse (Equus caballus) and an ass (Equus asinus) necessary for the production of a mule? Are not all mules wholly sterile? A. Mules are the offspring of an ass and a mare. The offspring of a stallion and an ass is called a hinny. See Webster's Dictionary. These hybrids are usually sterile.

(7964) H. N. asks: Will you kindly inform me through Notes and Queries the composition of a liquid which, when applied to metals such as brass, copper or steel, gives a coating of silver? An article is on the market called Silver-all which does this by applying the liquid on a rag and rubbing the article, which produces the silver effect. A. Small articles may easily be coated with silver by dipping them first into a solution of common salt, and rubbing with a mixture of one part of precipitated chloride of silver, two parts of potassa alum, eight parts of common salt, and the same quantity of cream of tartar. The article is then washed and dried with a soft rag.

(7965) J. N. H. asks: 1. If a magnet be applied to the end of an iron bar of indefinite length, how far along the bar will the magnetism extend and what is the formula for determining what the magnetic strength would be at any point along the bar? A. We do not know. The subject of magnetic force is treated in Fleming's "Magnets and Electromagnets," price $3 by mail. 2. Where can I get information on the relation between magnetism and light? A. Consult any of the larger text books of physics, Barker or Ganot. The works of Clerk Maxwell contain the original presentation of the subject.

(7966) W. W. P. asks: 1. What will prevent films and plates getting soft during development and fixing? I use cold water with ice in the fixing bath. A. Use a cold developer. It is too late to apply the remedy when the plate has reached the fixing bath. The acid fixing bath, now commonly prescribed in all circulars of instructions, will harden the gelatin and usually prevent trouble. 2. What will prevent holes forming in the film on the plate during drying. While drying the last plates I set some down face up on a table where nobody touched them, but several hours later they were full of holes varying in size from $\frac{1}{32}$ to $\frac{1}{16}$ inch. Can you explain the cause? A. Transparent spots or pin holes arise from a variety of causes. Dust on the plate when exposed, air bubbles on the plate not detached when it is put in the developer, impure water used in making the developer, are the principal causes. Each of these causes has its obvious remedy. The principal plate makers issue small manuals for the guidance of those using their plates. Write to the maker of your favorite plate and ask for a copy. You can then study the mode of handling the plates. 3. Is it possible to save any nitrate of silver from the first washing and from the hypo bath? If so, please tell me the method? A. Precipitate the silver from the solution by adding sodium bicarbonate or sodium chloride. Then reduce by any of the processes for reducing silver, for which see the chemistries. 4. In a recent issue of the SCIENTIFIC AMERICAN I saw that gold could be saved from the toning bath by means of sulphate of iron. It said to dissolve two ounces of iron sulphate in a quart of hot water, so I tried it but the iron sulphate would not dissolve but turned red and sank to the bottom of the bottle. Will you please tell me the reason? A. Use ferrous sulphate with which to precipitate the gold in a finely divided state. The ferrous sulphate absorbs oxygen very rapidly and changes to the red ferric compound.

NEW BOOKS, ETC.

PHYSICS OF THERMO-CHEMISTRY. By Gustaf M. Westman. New York. 1900.

Energy manifests itself in many forms, and universal science has adopted the name of potential energy for the absorption of kinetic energy. Physical energy can be stored in matter; for example, in the form of latent heat, but we have another form which is dealt with particularly in this treatise, namely, the potential energy, which is called volume energy, and which in chemistry takes an important part. The purpose of this work is to find a relation between the change of volume, which takes place in the matter, and the potential energy, which is liberated or taken up by such change. The author's calculations are based entirely upon the values of heat and energy found experimentally, and he has found the mathematical expression for the latent heat. He uses the ordinary adiabatic formula, in which the inner as well as the outer work takes place. The application of the formula perfectly agrees with values of latent heat, which for certain bodies have been experimentally found. For as many reactions as complete data in regard to specific weights and combination heat have been found, the author shows that his formula either directly or indirectly applied, will give a correct mathematical expression of the changes in volume which the constituent parts in the reaction are subjected to. It is, therefore, claimed that his formula represents the general law for chemical mechanism, and moreover that by analogies the heat of the reaction can be determined, which could not be done by experiments.

A FRENCH-ENGLISH MILITARY TECHNICAL DICTIONARY. By Cornélis De Witt Willcox. First Lieutenant of Artillery, U. S. A. Washington: Adjutant General's Office. 1900. Octavo. Pp. 492.

Lieutenant Willcox has performed a task for which he deserves the thanks of every scientific translator. He has compiled a technical dictionary of French-English military terms, which for scholarly completeness and accuracy of definition merits unstinted praise. We have used the first two parts of his work for the past year and found them trustworthy guides. In these parts a few terms have been omitted which might possibly have been inserted. Among them are to be noted *carter*, *carrelage*, *chasse-corps*, *commutatrices*, *métal deployé*, *fringalage*.

THE UNIVERSAL SOLUTION FOR NUMERICAL AND LITERAL EQUATIONS. By which the Roots of Equations of all Degrees can be Expressed in Terms of their Coefficients. By M. A. McGinnis. Kansas City, Mo.: The Mathematical Book Company. 1900. Pp. 195.

By an ingenious combination of geometry and algebra, Mr. McGinnis seems to have considerably simplified the problem of solving biquadratic and the higher algebraic equations. His explanations are not always perfectly clear; nor are his definitions faultless. The explanation of an imaginary quantity (definition 22) is decidedly obscure. It is difficult to understand what advantage the definitions on page 5 of his book have over those ordinarily in use, or what a "proposed proposition" may be (definition 33). On page 239, section 273*a*, an equation is given in which an x is clearly missing. These *gaucheries* are pointed out, not for the sake of being hypercritical, but because they materially detract from an otherwise very valuable contribution to mathematical science.

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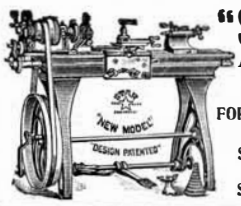

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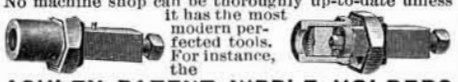

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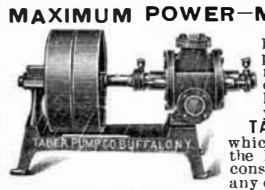

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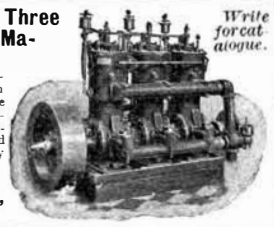

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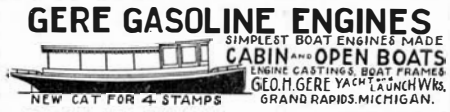
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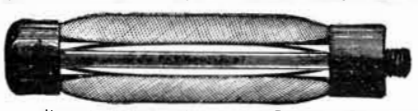

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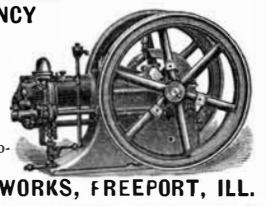

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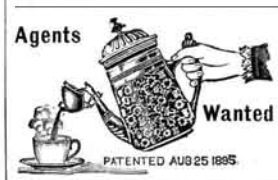

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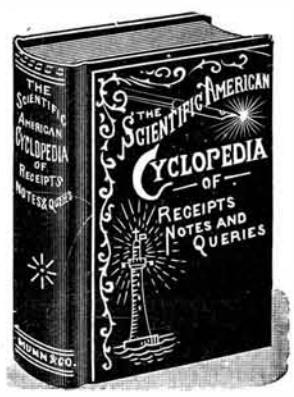

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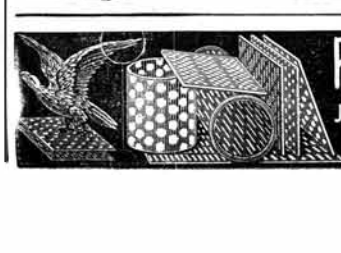

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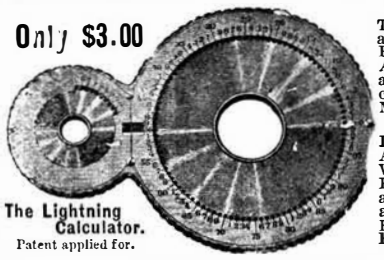

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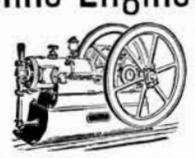

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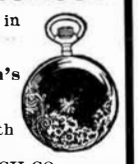

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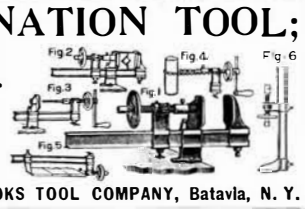

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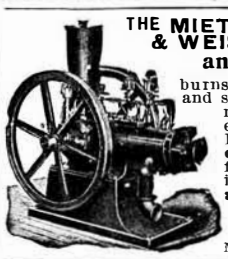

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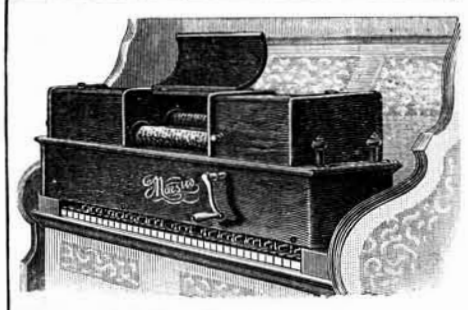

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